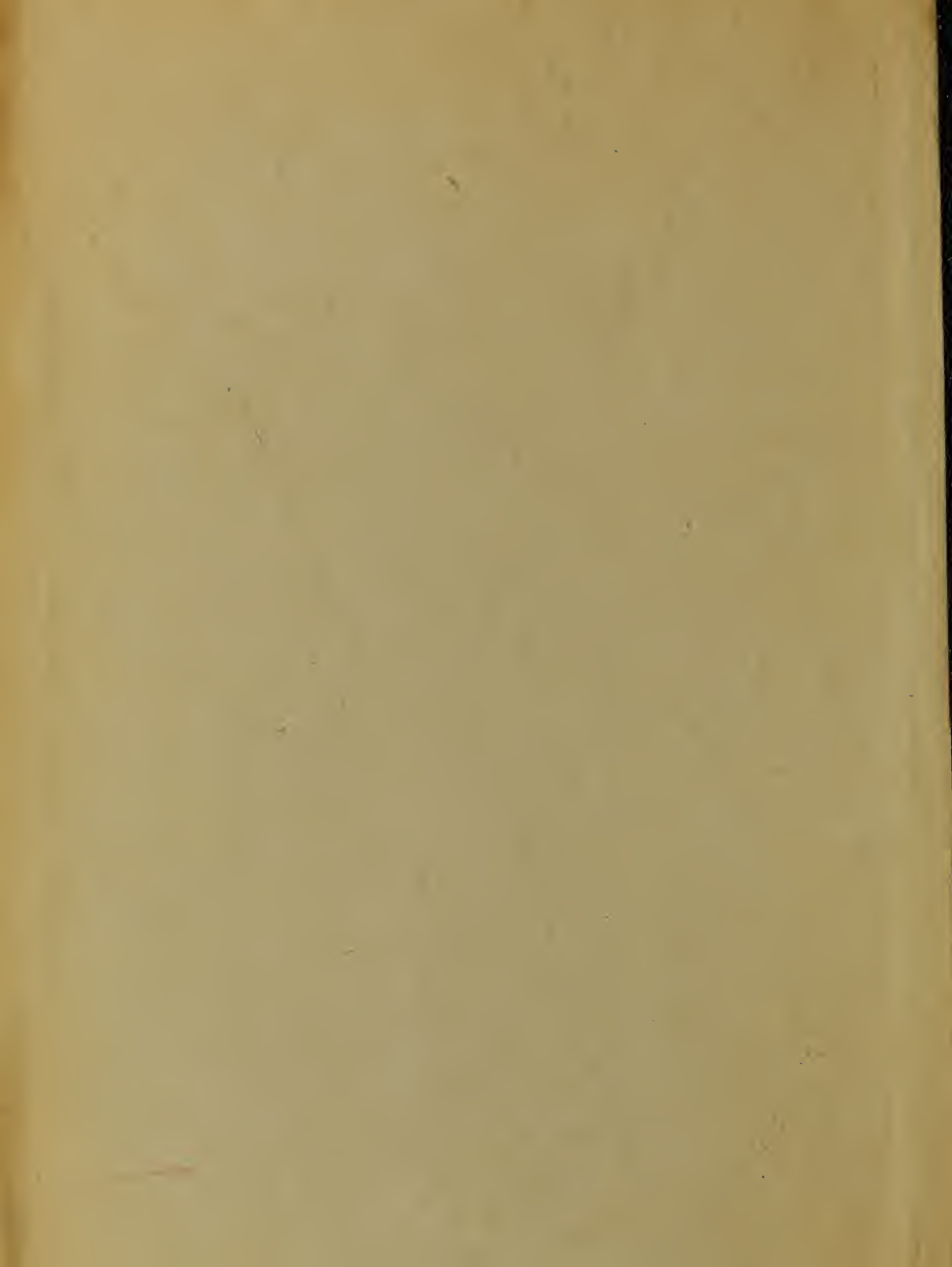


AM
1938
by

Byrnes, H. B.



BOSTON UNIVERSITY

GRADUATE SCHOOL

Thesis

MINOR PLANT FIBERS

by

Hazel Barstow Byrnes

(B.S. in Ed., Boston University, 1929)

submitted in partial fulfilment of the
requirements for the degree of

Master of Arts

1938

AM
1938
by

APPROVAL BY READERS

FIRST Stuart K. Harris

SECOND B. R. Lutz

Outline: Minor Plant Fibers

Introduction

Page
1

Minor Fibers of Monocotyledonous Plants

Minor Fibers of Dicotyledonous Plants

Origin, Locations, Structure of Fibers

I. Economic Classification of Fibers:-	Textile Fibers	7
A. Surface Fibers:	Cotton (omitted)	
B. Soft, bast fibers		
1. Hemp: Moraceae: (Cannabis sativa)		8
2. Urticaeae: Ramie or China Grass.		9
3. Sunn Hemp: (Leguminosae: Crotalaria)		11
4. Colorado River Hemp: (Leguminosae: Sesbania); For bowstrings, nets.		11
5. Jute: Corchorus: (Tiliaceae).		12
6. China Jute or Indian Mallow: (Abutilon Avicennae): Malvaceae		18
7. Gambo or Deccan Hemp: (Malvaceae): (Hibiscus cannabinus) for canvas.		18
8. Rama: (Hibiscus Sabdariffa): Jute substitute in weaving and paper-making.		18
9. Araminta: (Malvaceae): (Urena lobata): Fiber for coffee sacks		
10. Okra: (Malvaceae): (Hibiscus esculentus): Fiber for weaving		
11. Majugua (Malvaceae): (Hibiscus tiliaceus): Fiber for coarse textiles.		
12. Cuban Jute (Malvaceae): (Sida rhombifolia): For bagging for sugar and tobacco: cigar ties;		
13. Indian Hemp: (Apocynaceae): (Apocynum cannabinum): For cord- lines, nets, bowstrings.		18

1

2

3

4

5

6

7

8

9

	Page
C. Hard or Structural Fibers	19
Tropical monocotyledons: Leaves, stems, fruits.	
1. Coir: <i>Cocos nucifera</i> (Palmaeaceae): Coconut Fiber.	19
2. Pineapple: <i>Ananas</i> : (Bromeliaceae).	20
3. New Zealand Hemp: <i>Phormium tenax</i> : Liliaceae.	22
4. Bowstring Hemp: <i>Sansevieria</i> : Liliaceae.	22
5. Henequen: <i>Agave</i> : Amaryllidaceae.	24
6. Sisal: <i>Agave</i> : Amaryllidaceae.	25
7. Istle or Ixtle or Tambico Fiber: <i>Agave</i> : Amaryllidaceae.	26
8. Maguey: <i>Agave</i> : Amaryllidaceae.	27
9. Mauritius Hemp: <i>Furcraea</i> : Amaryllidaceae.	27
10. Manila Hemp: <i>Musa textilis</i> : Musaceae: called Abacá.	28
Rope-Making.	29
II. Brush Fibers	32
A. Bamboo Splits: <i>Arundinaria</i> : Gramineae.	32
B. Broomroot: <i>Episcampes macroura</i> : Gramineae.	33
C. Broomcorn: <i>Sorghum vulgare technicum</i> : Gramineae.	33
D. Wheat Straw: <i>Triticum</i> : Gramineae.	34
E. Brazilian Piassava: <i>Attalea funifera</i> : Palmaeaceae.	34
F. Palmyra Fiber: <i>Borassus flabellifer</i> : Palmaeaceae.	35
G. Kittul Fiber: (<i>Caryota urens</i>): Palmaeaceae.	35
H. Coir and Coconut Leaves: <i>Cocos nucifera</i> : Palmaeaceae.	35
I. Para Piassava: <i>Leopoldinia Piassaba</i> : Palmaeaceae.	36
J. West African Piassava: <i>Raphia vinifera</i> : Palmaeaceae.	36
K. Palmetto (<i>Serenoa serrulata</i>): Palmaeaceae.	36
L. Istle Fiber: <i>Agave Lecheguilla</i> : Amaryllidaceae.	37



Digitized by the Internet Archive
in 2014

<https://archive.org/details/minorplantfibers00byrn>

III. Plaiting and Rough Weaving Fibers	37
A. Hat Fibers	
1. a. Pandanus tectorius: Pandanaceae	38
b. Pandanus utilis and others: Pandanaceae	38
2. Straws: Graminaceae	
a. Wheat	39
b. Rice	39
c. Barley	40
d. Rye	40
3. Raffia: Raphia pedunculata	41
4. Puerto Rico Hat Palms: Sabal causiarum: Palmaceae	41
5. Panama Hat Palm: Carludovica palmata: Cyclanthaceae	41
6. Vegetable Sponge: Luffa cylindrica: Cucurbitaceae	42
B. Baskets and Fibers Used	43
1. Indian Baskets: New and Old	43
a. Woven Baskets	
b. Sewed or Coiled Baskets	
2. Fern: Filicineae	46
3. Spruce: Picca: Pinaceae	47
4. Pine Needles: Pinus: Pinaceae	48
5. Grasses: Graminaceae	49
6. Corn Husks: Graminaceae: others.	
5. Palm Fibers: Palmaceae	
9. Raffia: Raphia: Palmaceae	51
7. Green Rush: Juncaceae	
10. Willow: Salix: Salicaceae	52
11. Birch: Betulaceae	
12. Black Elm: Ulmus: Ulmaceae	53
13. Witch Hazel: Hamamelis virginiana: Hamamelidaceae	53

	Page
III. C. Mats and Matting	55
1. Shoestring Fern: <i>Vittaria lineata</i> : Filicineae	56
2. Western Red Cedar: <i>Thuja plicata</i> : Pinaceae	56
3. Graminaceae	56
a. Job's tears: <i>Coix lachryma Jobi</i>	56
b. Rice Straw Matting: <i>Oryza sativa</i>	57
c. Wheat Straw: <i>Triticum</i>	57
4. Sedges: Cyperaceae	
a. Chinese Mat Grass: <i>Cyperus tetetiformis</i>	57
b. English Sedge: <i>Cyperus</i>	
5. Palms: Palmaceae	
a. Coconut: <i>Cocos nucifera</i>	58
b. Sago: <i>Metroxylon Sagu</i>	58
c. Date: <i>Phoenix dactylifera</i>	59
d. Wild Date: <i>Phoenix sylvestris</i>	59
6. Japanese Mat Rush: <i>Juncus effusus</i> : Juncaceae	60
7. British Rush - <i>Juncus acutus</i> and others: Juncaceae	60
8. Raffia: <i>Raphia pedunculata</i>	61
IV. Filling Fibers	62
A. Seaweed Fibers: <i>Posidonia australis</i> : Thallophyta	63
B. Sphagnum Moss: <i>Sphagnum</i> : Bryophyta	63
C. Pine-Needle Wool: <i>Pinus palustris</i> : Pinaceae	63
D. Grain Straw Stuffings: Graminaceae	64
E. Crin vegetal: <i>Chamaerops humilis</i> : Palmaceae	64
F. Coir Fiber: <i>Cocos nucifera</i> : Palmaceae	64
G. Oil Palm Fiber: <i>Elaeis guineensis</i> : Palmaceae	65

	Page
H. Spanish Moss - <i>Tillandsia usneoides</i> : Bromeliaceae	65
1. <i>T. fasciculata</i>	
2. <i>T. lindeneana</i>	
I. Kapok: <i>Ceiba pentandra</i> : Bombacaceae	66
J. White Silk Cotton: <i>Cochlospermum Gossypium</i> : Cochlospermaceae	67
K. Madar: <i>Calotropis gigantea</i> : Asclepiadaceae	67
L. Other Fibers	
V. Natural Fabrics	68
A. Rabannas: <i>Raphia pedunculata</i> : Palmaceae	68
B. Upas Tree Bark Cloth: <i>Antiaris toxicaria</i> : Moraceae	68
C. Tapa Bark Cloth: Paper Mulberry: <i>Broussonetia papyrifera</i> : Moraceae	
D. Mutshu Cloth: <i>Ficus utilis</i> : Moraceae	69
E. Cuba Bast: <i>Hibiscus elatus</i> : Malvaceae	69
F. Lace Bark: <i>Lagetta lintearia</i> : Thymelaeaceae	69
G. Tauary Cloth: <i>Couratari Tapari</i> : Lecythidaceae	69
H. Vegetable Sponge: <i>Luffa cylindrica</i> : Cucurbitaceae	69
VI. Conclusion	70
VII. Bibliography	72

1935 Imports
Important Raw Fibers

Abaca	43,687 Tons
Broomcorn	2,646 Sh. Tons
Broomroot	28,512 Lbs.
Coir	848 Tons
Cotton	14,797 Tons
Crin Vegetal	5,495 Tons
Flax	3,367 Tons
Hemp	764 Tons
Henequen and Sisal	125,931 Tons
Istle	8,747 Tons
Jute	54,774 Tons
Jute Butts	10,763 Tons
Kapok	12,385 Tons
Maguey	1,644 Tons
Palm Leaves	23,367 Tons
Raffia	458 Tons
Ramie	2 Tons
Sunn Hemp	561 Tons

(from
Hill's Economic Botany: page 61).

2. The second part of the document focuses on the implementation of the proposed changes. It details the steps involved in the process, from initial planning to final execution. This section highlights the challenges faced during the implementation phase and provides strategies to overcome them. It also discusses the role of different departments in ensuring a smooth transition.

3. The third part of the document addresses the financial aspects of the project. It provides a detailed breakdown of the costs involved and compares them with the expected benefits. This section also includes a risk assessment, identifying potential financial risks and how they can be mitigated. The goal is to ensure that the project is financially viable and sustainable in the long term.

4. The fourth part of the document discusses the impact of the project on the organization. It analyzes the changes in performance metrics and the overall health of the organization. This section also includes feedback from stakeholders, providing insights into their perceptions and suggestions for improvement. The goal is to ensure that the project has a positive and lasting impact on the organization.

5. The fifth part of the document provides a conclusion and a summary of the key findings. It reiterates the importance of the project and the steps taken to ensure its success. This section also includes a final assessment of the project's outcomes and a plan for future actions. The goal is to provide a clear and concise summary of the project's progress and the lessons learned.

I. Minor Fibers: Introduction

Fiber (from the Latin fibra) refers to objects of a stringy or thread-like character, of the vegetable kingdom and is found in the stems, roots, leaves, fruits, and even the seeds of plants. The useful vegetable fibers are very numerous. Wood-cells are found in the bark, and are longer, finer, and tougher than those found in the wood. They form the principal part of the fibrous bark or bast layer of cells. These give toughness and flexibility to the structure and the extracted bundles of cells form the filamentous product, known as flax, hemp, ^{or}jute derived from dicotyledonous plants.

In monocotyledons, the fibrous cells are built up with others into a composite structure known as fibrovascular bundles. Such fiber occurs in the palms and in the fleshy-leaved agaves, the bundles being found not in bark, but throughout the stem or leaf forming the supporting structure. These filaments, when separated from the soft cell-mass by which they are surrounded, are known as structural fiber, of which the fiber of sisal hemp is an example.

The simple cells produced on the seeds of endogens, such as the coconut, constitute a fibrous material which is called surface fiber. Fiber bundles whether occurring as bast fiber or structural fiber are the spinning units; aggregations of bundles, purified and cleansed of all extraneous matter and twisted together.

The fibers of the leaves of endogens being parallel to each other are arranged in unified lengths for economical purposes; while the reticulated fibers of leaves of exogens are often of sufficient length and easily separated. The separation is accomplished by steeping in water or by

frequent dampening with water to promote rotting of the other parts of the bast, and of the bark which covers it. The fibers of endogens are in general discolored and injured by this damp process to a much greater degree than are exogens. Here mechanical means are usually preferred for their separation, as beating, scraping and passing between rollers. The fibers of many leaves are separated by scraping alone.

Plants that yield fibers have been second only to food plants in their usefulness to man and their influence on the advancement of civilization.

Primitive man in his attempt to obtain the three great necessities of life--food, shelter, and clothing - early turned to plants.--He needed some form of clothing that was lighter and cooler than skins and hides. For his snares, bowstrings, nets,.he needed some form of cordage that was easier to procure than animal sinews and strips of hide. Moreover, some other type of covering for his crude shelters was desirable. All these needs were met by the tough, flexible strands that occurred in the stems, leaves, and roots of many plants. (Hill's Botany, p. 21).

As civilization advanced and man's needs multiplied, the use of these vegetable fibers increased, until at the present time they are of enormous importance in our daily life, well over a thousand species of fiber plants being in use. Some of the most prominent fibers of the present day are of great antiquity. Ramie or China grass has been grown in the Orient from time immemorial.

Fiber signifies the vegetable tissues used in the arts. Vegetable fibers are derived from the cellular structure or tissue of plants the cells of which vary in diameter from one three-hundredth to one five-hundredth of an inch, the smaller sizes admitting 125,000,000 cells to a cubic inch.

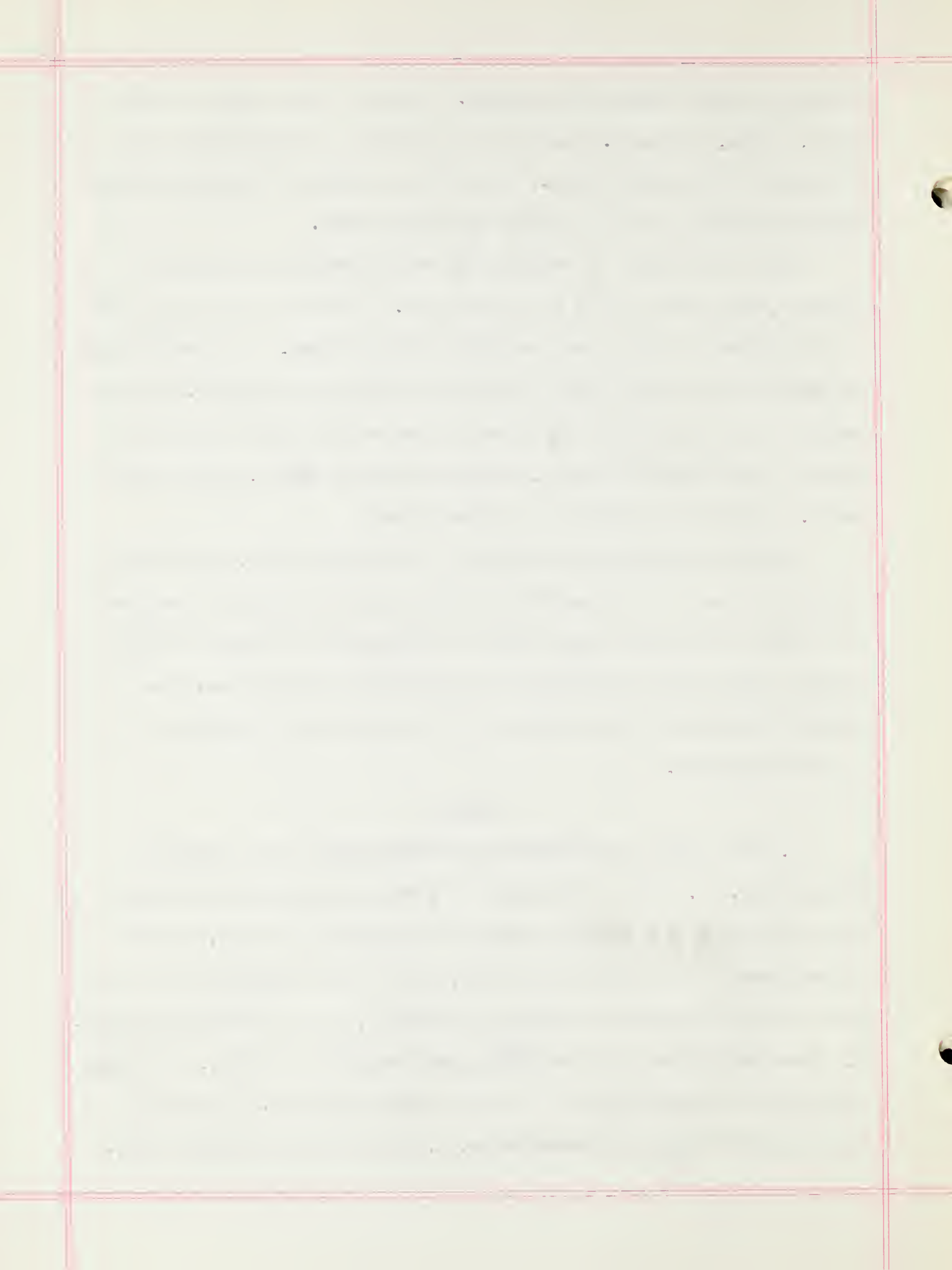
The walls contain lignin and cellulose. There are three forms of cells: woody, simple, and ducts. Woody fiber is formed by the lengthening and thickening of the simple cells. The ducts or vessels are large cylindrical cells whose walls have been absorbed and broken away.

Wood cells consist of tubes one or two thousandths of an inch in diameter, their ends pointed and overlapping. When they occur in the bark of dicotyledonous plants they are known as "bast" fiber. In monocotyledons as palms and the century plant they form "fibrovascular bundles". Even the common or simple cells form a valuable fiber material when they are produced on the surfaces of leaves, stems and seeds of plants, in the form of hairs. This fibrous substance is surface fiber.

The stems and twigs, and even wood of exogenous trees, divided into splints and used for basket-making are designated as fiber; also the stem and leaves of endogenous plants split or used entire as "rattan" or when coarsely split for weaving, "divided for plaiting", as hat straws. The stripped epidermes of palm leaves is a fiber as raffia of commerce yet it is not filamentous.

Fibers

1. "Bast fibers are derived from the inner bark of the stems of dicotyledons.
2. Woody fibers may be the woody stems and twigs of exogenous plants which are split into withes for basketry or cordage, or for coarse thread for stitching and binding, (as in canoe manufacture); or the wood reduced to splints for baskets or excelsior, or for pulpwood for paper.
3. Structural fibers come from ^{the} structural system of the stalks, leaf stems and leaves of monocotyledonous plants as agaves and palms. They give the plant rigidity (Americana Encyclopedia, p. 166) and serve as water ducts.



4

Split or shredded they give "straw plait". Fibrous portions of the leaf deprived of their epidermis and soft cellular tissue give 'vegetable wool' as in pine needles. 4. Surface fibers may be hair surrounding seed as in cotton, or hair-like growths produced on the surfaces of stems, leaves, or leaf-buds of plants known as 'pulu'; or fibrous material produced in epidermal strips from endogens as raffia. 5. Pseudo-fibers are fibrous materials used in packing and as substitutes:-

- A. Certain mosses for packing
- B. Marine weeds and leaves
- C. Seaweeds wrought into fish-lines or cordage
- D. Fungus growths employed in economic uses as fibers."

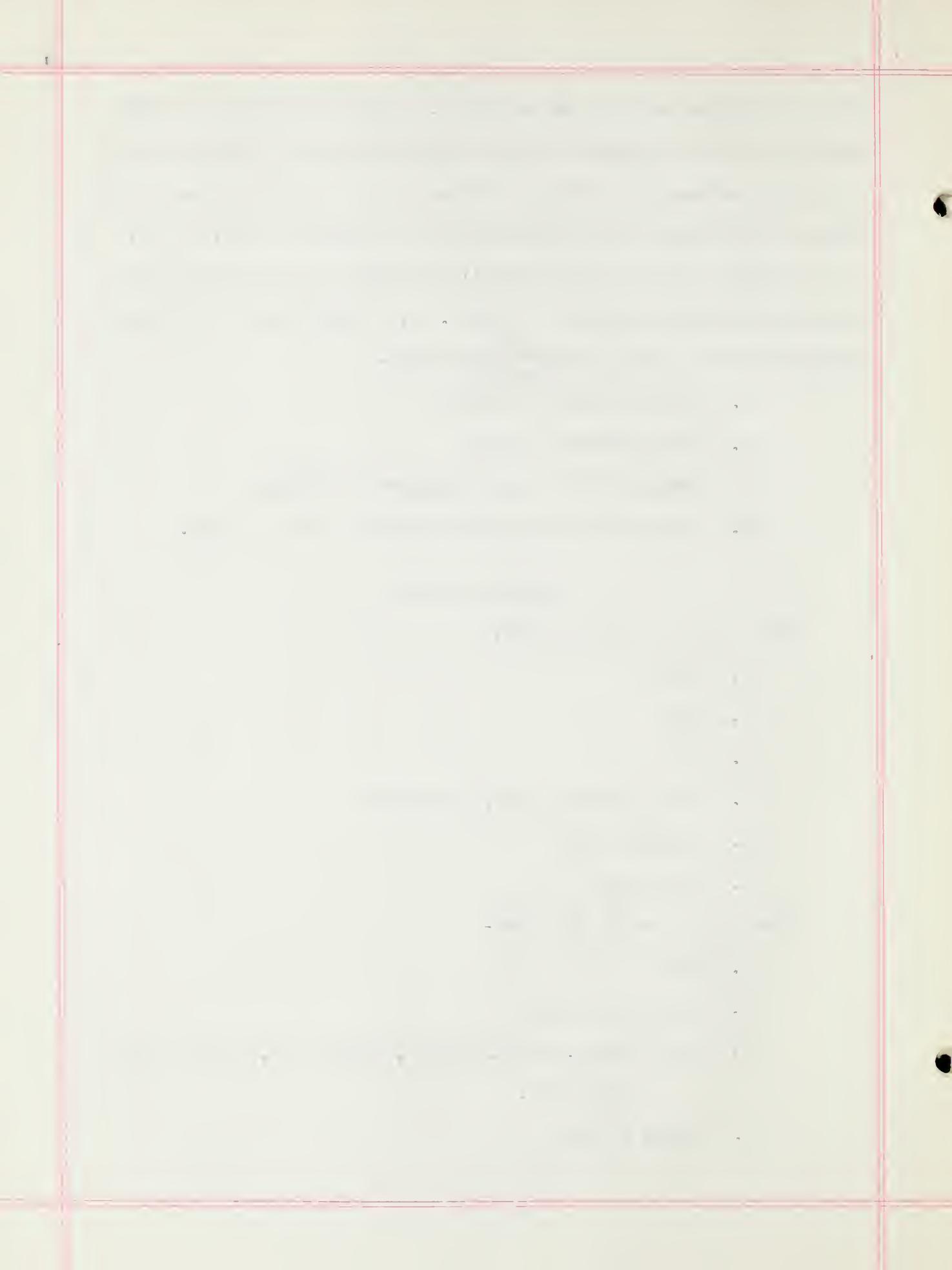
Spinning Fibers

"The fibers of first rank are:-

- A. Cotton
- B. Flax
- C. Hemp
- D. Ramie for laces, nets, knit goods
- E. Pineapple Fiber
- F. Manila Hemps

Fibers of the second rank are:-

- A. Jute
- B. Coconut Fiber: Coir
- C. Agaves: Gunny, budlap, webbing, rough sacks, coarse floor coverings.
- D. Netting fibers



E. Grass fibers (nets, hammocks, etc.)

F. Hard Fibers - Cordage

1. Manila
2. Sisals
3. Coir
4. Sunn Hemp
5. Mauritius Hemp
6. Bow-string Hems
7. New Zealand Flax (twines)
8. Tampico (twines)
9. Okra (in hand manufacture)
10. Majagua
11. Cuban Jute
12. Indian Hemp
13. Aramina

"Tie material" is the peeled bark of trees rich in bast, stripped or shredded palm leaves, the tougher grasses, ^{bamboo and} ~~for rope~~ /suspension bridges, or twigs and roots twisted into cordage for building native huts and enclosures. Raffia is an example.

Natural Textures are the natural woven fabrics of tropical countries: the bark, or stems, and beaten 'Tapa cloth' of the Pacific Islands. Others are lace-barks, the satin-like Cuba bast employed in ladies hats, ribbon bast used for cigarette wrappers. Rough twistings are used for cordage." (Americana Encyclopedia, Vol. II, p.167)

4

2

1

Brush Fibers are:

- A. Tampico
- B. Palmetto
- C. Palmyra
- D. Kitool (Brushes)
- E. Monkey Bass
- F. Piassaba
- G. Cocoa Fiber
- H. Broomcorn coarser
- I. Broomroot
- J. Twigs and splints (for street sweeping)

Plaiting and Rough Weaving Fibers are more important to the natives where they grow than to the commercial world. They are used in articles of attire and ornament for domestic economy. The most important, commercially are:

- A. Straw-plaits (from wheat, rye, barley, and rice straw.)
- B. Carludovica (split from palm leaves: Panama hats)
palmata
- C. Chip (for millinery, from tree basts and close-grained woods)
- D. Grass mattings
- E. Thatching fibers
- F. Basketry fibers: palm fibers, grasses, reeds, rushes, yucca
fiber, leaf stems, ferns, splints from pine, ash, hickory.
- G. Willow ware for furniture, chair seats
- H. Screen panels using bamboo, osier, rattan, rushes, and splints.

2. The second part outlines the various methods used to collect and analyze data, including surveys, interviews, and focus groups. It also describes the statistical techniques employed to interpret the results.

3. The third part presents the findings of the study, highlighting the key trends and patterns observed. It includes a detailed analysis of the data and discusses the implications for future research and practice.

4. The fourth part concludes the document by summarizing the main points and providing recommendations for further action. It also includes a list of references and a bibliography.

5. The fifth part contains a list of appendices, which provide additional information and data related to the study. These include raw data, detailed calculations, and supplementary figures.

6. The sixth part is a list of figures and tables, which are used to present the data in a clear and concise manner. These include line graphs, bar charts, and tables of data.

7. The seventh part is a list of tables, which provide a detailed breakdown of the data. These include tables of means, standard deviations, and other statistical measures.

8. The eighth part is a list of figures, which are used to illustrate the data. These include line graphs, bar charts, and other visual representations of the data.

9. The ninth part is a list of tables, which provide a detailed breakdown of the data. These include tables of means, standard deviations, and other statistical measures.

10. The tenth part is a list of figures, which are used to illustrate the data. These include line graphs, bar charts, and other visual representations of the data.

Fibers of economic importance are furnished by many different families of plants from the tropics:-

Graminaceae	Palmaceae
Urticaceae	Musaceae
Malvaceae	Liliaceae
Linaceae	Amaryllidaceae
Bombacaceae	Moraceae
Leguminosae	Tiliaceae
Bromeliaceae	

I. Economic Classification of Fibers

Textile Fibers: Textile fibers must be long and have a high tensile strength, together with cohesiveness and pliability. They must have a fine, uniform lustrous staple and be durable and available. Three classes of textile fibers are:-

- A. Surface fibers
- B. Soft fibers
- C. Hard fibers

"Textile Fibers.- The most important use of fibers is for the textile industry, which is concerned with the manufacture of fabrics, netting and cordage. In making fabrics and netting, flexible fibers are twisted together into thread or yarn and then woven, spun, knitted, or otherwise utilized. Fabrics include cloth for wearing apparel, domestic use, awnings, sails, gunny and burlap. Netting fibers are used for curtains, lace, hammocks, and all forms of nets including many of the commercial fish nets and native insect and bird nets as well. Both commercial and native fibers are

THE UNIVERSITY OF CHICAGO

DEPARTMENT OF CHEMISTRY
5408 S. DICKINSON DRIVE
CHICAGO, ILL. 60637
TEL. 773-835-3100
FAX 773-835-3101
WWW.CHEM.UCHICAGO.EDU

CHICAGO, ILL. 60637

CHICAGO, ILL. 60637

CHICAGO, ILL. 60637

CHICAGO, ILL. 60637

CHICAGO, ILL. 60637

used for cordage. For this purpose the individual fibers are twisted together instead of woven. Twine, binder twine, fish lines, rope, hawsers, and cables are types of cordage." (Americana Encyclopedia, page 165.)

Hemp: Moraceae

True hemp is a stout, bushy, branching annual, varying from five to fifteen feet in height. It is *Cannabis sativa*. The plant is dioecious with hollow stems and palmate leaves. Male plants give the best grade of fiber. The fiber is a white bast fiber which develops in the pericycle, and it is strong and durable. It lacks the elasticity and flexibility of flax due to lignium. Hemp requires a mild, humid climate and a rich, loamy soil filled with humus. Calcareous soils are well adapted for its growth.

"The yield of hemp is large; an acre produces two to three tons of stems. (Hills Botany, p. 33). Twenty-five per cent is fiber. The plants are harvested by machine or they are pulled from the ground and stripped of their leaves and soaked until the fibers are free. The fibers are then broken and hackled by hand. The ideal harvest time is when the male flowers are in full bloom, for then the fibers are strongest and they are not brittle. Hemp often grows as a weed in grain fields. It is native to Central and Western Asia, but it is extensively cultivated at present in temperate and tropical regions.

It has been raised in Europe since 1500 B.C.; and the chief countries raising hemp are France, Russia, Italy and Hungary. Hemp has been raised in the United States since 1775 in Kentucky, Indiana, Wisconsin, California and the Central Mississippi Valley." Russia produces the greatest crop and Italy, around Bologna, raises the finest quality using the fiber as an

1. The first part of the paper discusses the importance of the study of the history of the United States. It is argued that a knowledge of the past is essential for a full understanding of the present and for the development of a sense of national identity.

2. The second part of the paper discusses the role of the federal government in the development of the United States. It is argued that the federal government has played a central role in the development of the country, and that its actions have shaped the nation's history.

3. The third part of the paper discusses the role of the states in the development of the United States. It is argued that the states have played a central role in the development of the country, and that their actions have shaped the nation's history.

4. The fourth part of the paper discusses the role of the people in the development of the United States. It is argued that the people have played a central role in the development of the country, and that their actions have shaped the nation's history.

5. The fifth part of the paper discusses the role of the economy in the development of the United States. It is argued that the economy has played a central role in the development of the country, and that its actions have shaped the nation's history.

6. The sixth part of the paper discusses the role of the culture in the development of the United States. It is argued that the culture has played a central role in the development of the country, and that its actions have shaped the nation's history.

7. The seventh part of the paper discusses the role of the environment in the development of the United States. It is argued that the environment has played a central role in the development of the country, and that its actions have shaped the nation's history.

8. The eighth part of the paper discusses the role of the future in the development of the United States. It is argued that the future has played a central role in the development of the country, and that its actions have shaped the nation's history.

adulterant of silk." (Redway's Geography, p. 121 and 257.)

Other uses for the fiber are: ropes, twines, carpets, sailcloth, yacht cordage, sacks, bags and webbing. Hemp waste and stem wood goes into paper-making. "Finer grades are woven into a coarse cloth resembling linen. Cigarettes, illicitly made from Cannabis hemp leaf fiber and known as 'Marijuana' have found their way into the United States." (Robbins' Plants Useful to Man, p. 181). The tow and ravelings give 'oakum' and it is used to caulk the seams between the planking; in cooperage and as a packing for pumps and engines. In Jamaica and the Nassau Islands natives dye the fibers, weave them into small braids, and work them into pocket-books, bags, baskets, and table mats for tourists. In the basket markets the fiber-to-product processes are colorful and fascinating to the visitor.

Ramie or China Grass: Urticaceae

Boehmeria tenacissima and *B. nivea* shrubs are five to eight feet high and produce the best fiber in the inner layer of their bark. The trees are native to Malaya. These two shrubs give the China grass fiber of commerce. *B. nivea* is a perennial-rooted, herbaceous or shrubby plant without branches when cultivated. The leaves are heart-shape, and the fiber has a high degree of luster resembling silk in brilliance, strength and durability. "Ramie is finer and stronger than jute; it is little affected by moisture, and it will take dye-stuffs in a superior manner". (Redway's Commercial Geography: p. 123.)

Ramie is of Asiatic origin and it was known to the Chinese at an early time. China, Japan, Formosa, and India produce great amounts of ramie at the present time. Japan produces the most fiber for export trade. (Bulletin: Royal Kew Gardens: Watson on "India" pp. 1-2-7).

Ramie has been successfully cultivated for experimental purposes in the southern United States and in California. The yield is low, but several crops can be raised each season and each crop yields four tons of stems per acre. It can be delivered from the Orient to San Francisco for four cents per pound. Such a low price discourages its culture here. It will thrive in any soil and in areas where sudden temperature changes do not occur. Sometimes it is exported from Assam as "rhea" fiber.

Although this plant may be cultivated extensively and yields an abundance of fiber, its development will not increase until the fiber may be more cheaply separated from the rest of the plant. In China where labor is abundant and cheap, the fiber is removed by a slow and tedious process of hand labor. Many decorticators have been invented to do this work, but have not been successful, since they bruise or injure the fiber and they do not squeeze out the gum thoroughly. In addition, the problem of producing ramie is handicapped by the varied lengths of the fiber, as spinning is rendered difficult unless the fibers are separated into uniform groups. When machinery is introduced to separate and handle larger quantities of the fiber more of this fiber will be raised in the East and West.

Ramie takes first rank as a textile substance. It is made into shirtings for men's wear, ladies dress goods, upholstery, curtains, laces, embroideries, pile for velvet and plushes, stockings, knit goods, table damask, napkins, handkerchiefs, and sheeting. "Sail duck, carpets, cordage, fishing nets, and yarns and threads of all descriptions are made from this fiber. A superior bank-note paper is exported." (Americana Encyclopedia, p. 202). "In Europe ramie is made into dainty underwear, portieres, various types of writing paper. American "Smyrna" rug makers use ramie as a sub-

2. The second part outlines the various methods and tools used to collect and analyze data. This includes both traditional manual methods and modern digital technologies, highlighting the benefits of each approach.

3. The third part focuses on the role of the management team in overseeing the data collection process. It stresses the need for clear communication and coordination between different departments to ensure that data is collected consistently and accurately.

4. The fourth part discusses the challenges faced during the data collection process, such as incomplete data or discrepancies between different sources. It provides strategies to address these challenges and ensure the integrity of the data.

5. The fifth part concludes by summarizing the key findings and recommendations. It reiterates the importance of a robust data collection system and suggests areas for future improvement and research.

stitute for jute and it is nearly as durable as wool floor-covers."

(Hill's Botany, p. 37.) In China outside garments, underclothes, gas mantles, and canvas are woven from Ramie fibers.

Sunn Hemp: *Crotalaria*

Sunn hemp is an important Asiatic fiber plant, *Crotalaria juncea*, of the family Leguminosae. It is a shrubby annual and grows from six to ten feet in height, with bright yellow flowers. "The bast yields the fiber which is light in color, enduring and stronger than jute. It is the earliest fiber to be mentioned in Sanskrit, it is ^{not} known in the wild state because it has been cultivated for centuries. Ceylon, India and the Orient plant sunn hemp in the rainy season (Coulter's Botany, p. 417). Five hundred thousand acres of it are cultivated in India a year. The United States import a great quantity for coarse twines. "It is also made into cordage, coarse canvas, sacks, and woven into nets and coarse fabrics." (Hill's Botany, p. 37.)

Colorado River Hemp: *Sesbania*

Sesbania is a widely distributed tropical herb or shrub of the pea family Leguminosae, comprising about twenty species. *S. exaltata* is important in the southern United States. It is a coarse annual, eight to twelve feet high, grown chiefly as a cover crop or green manure in its native region and in California. *Sesbania* is the Latinized version of the Arabian name for a related species. The leaves are compound, the leaflets arranged feather-fashion without an odd one at the end. "It is only used as an annual, warm-country cover crop sown in early spring" (Garden Dictionary, p. 729). It is known as Colorado River hemp and the Western tribes of American Indians used the bast fibers for bowstrings and nets. (Hill's, p. 38)

Jute: Tiliaceae

Characteristics and Distribution. Two species of jute yield the jute of commerce, *Corchorus capsularis* and *C. olitorius*. They are tall shrubs eight to fifteen feet high. The fiber is produced in the bark and is known as bast fiber. Jute is supposed to be indigenous to India, where the species grow wild and it is cultivated by Chinese and Malays. *C. olitorius* is naturalized in all parts of the tropics to the Mediterranean shores. Jute was introduced into the United States by the Department of Agriculture in 1870 and was found to be adapted to cultivation from Texas to South Carolina. It is not as fine or as durable as linen.

The fiber of jute, compared with other raw fibers, is quite inferior,

and bleached filasse soon loses its whiteness and becomes a dingy, dirty brown, while its strength rapidly deteriorates. Nevertheless it may be regarded as one of our most useful fibers - too useful in certain directions as its finess and lustre, as well as cheapness, adapt it most readily to purposes of adulteration. It takes colors easily so it can be stained or dyed to imitate many of the other fibers, though such a substitution may be readily detected. The real China jute of commerce is not jute at all but a similar bast fiber derived from *Abutilon Avicennae*. This fiber was experimented with in New Jersey twenty-five years ago though unsuccessfully, the fiber being wrongly called American Jute.

In India many kinds of jute are recognized, all being known under local trade names. "The value of jute as a textile lies wholly in its fineness, silkiness and adaptability to spinning, low cost of the raw material being another advantage. Several American fiber plants classed as weeds yield a better, whiter and stronger fiber, though they cannot be utilized for economic reasons." (*Americana Encyclopedia*, Vol.16, p.267).

Culture of the Fiber. The requirements of commercial jute production are exacting. Although jute may be grown in many tropical places, its cultivation is confined almost exclusively to the eastern part of the Lower Ganges - Brahmaputra region to the east. Here more than ten million bales of jute are produced annually on three and one-half million acres of land. The successful cultivation of the crop in this place is due to a combination of factors - good soil, and an abundance of rain during the growing season, suitable water for retting purposes, and cheap labor. In addition, this area receives a moderate abundant rainfall before the summer monsoon has developed.

The quality of the fiber and the yield per acre depend in large measure upon the preparation of the soil. The ground should be plowed four times and all weeds removed. The farming operations, however, are simple and most of the agricultural implements are of crude construction. Plowing is done with wooden implements that have been faced with iron. After plowing, the rough clods are broken with hand mallets or a piece of timber that is dragged by a pair of bullocks. (Case and Bergsmark's College Geography, pages 207-209.)

The commercial use of jute dates back more than a century, the first export was made to England in 1728. By 1850 exports reached 30,000 tons; in 1871, 310,000 tons. Now 3,500,000 acres are cultivated in jute in India. Both high and low lands are employed for this culture, although the larger part of the crop is produced upon the churs or lands of recent alluvial formations along the rivers. In this country the river bottoms would be favorable for the culture. This ploughing of the land prepares it for the cleaning process, for which bamboos are provided with projecting pins to scratch the soil, and to collect the roots of the previous crop. For fertilizer farmyard manure, castor-cake and water hyacinth weed is used. The seed is sown by hand, and in a normal season the plant matures in three months. In localities of the South where the requisite conditions of heat and moisture prevail, twelve to fifteen pounds of seed are sown per acre. In India the yield is four hundred pounds of fiber per acre. Little or no cultivation is given the crop except transplanting and thinning. The plants mature in three months and the crop is harvested with a bell hook and sickle at the time when the flowers have begun to show and the seed has not yet appeared. If the plants are allowed to seed, the

fiber will be stronger and heavier, but harsher. In some districts, after harvesting the stalks are stacked in the field until the leaves drop off, while in other localities stacking is not practised.

After cutting the plant, the fiber is separated from the stalk by being immersed in water 8 - 30 days, the time depending upon the period of the year and upon the district in which the crop is raised. When the ryot (Indian farmer) decides that the bast fibers (layers in which the fibers are imbedded) may be separated from the core of the plant with sufficient facility, the work of "steeping" ceases and the process of "stripping" commences immediately.

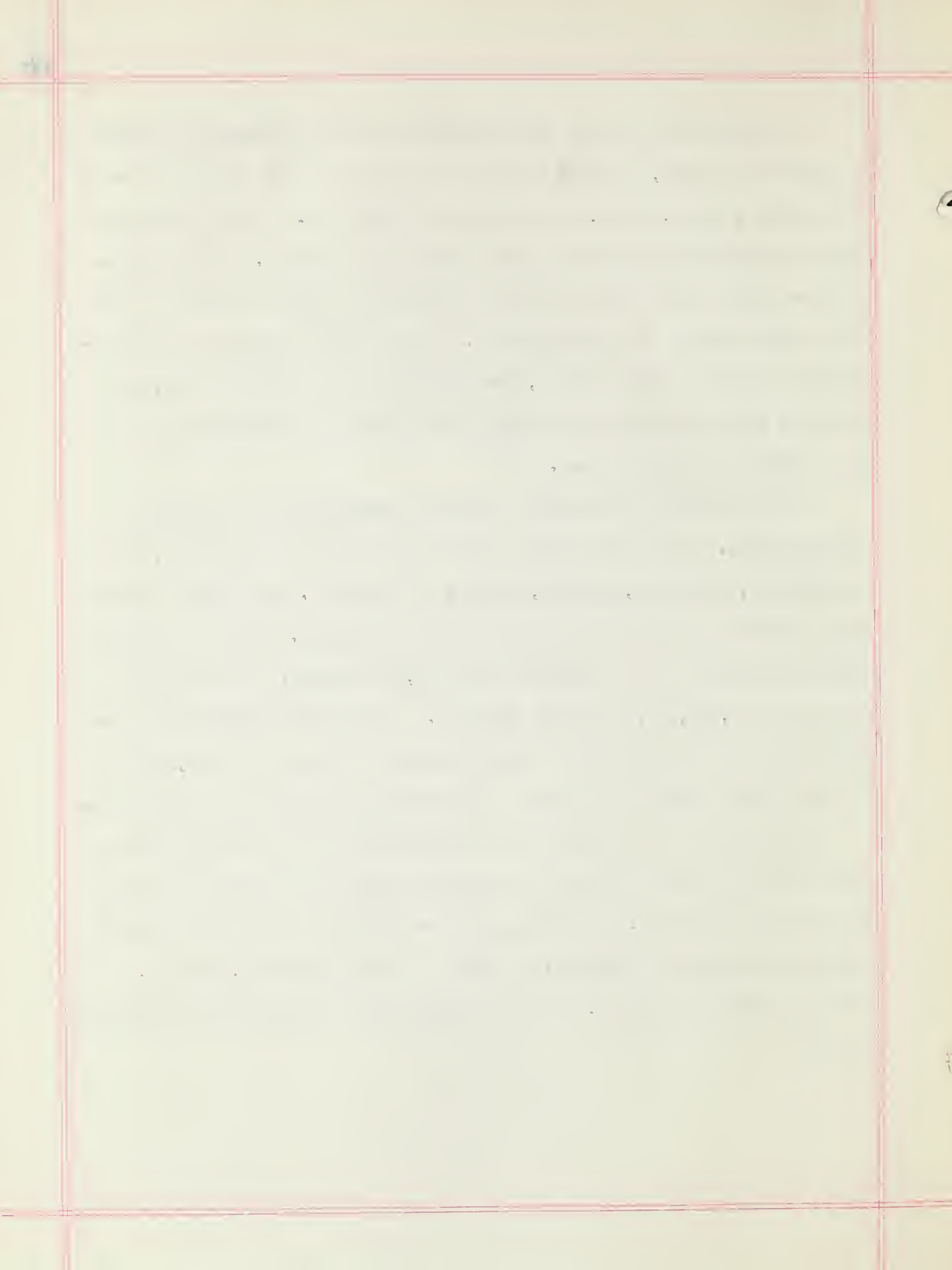
Preparation of Jute Fibers. The stalks are sorted into three sizes, and made into bundles that one man can carry. The extraction of the fiber is accomplished by steeping the bundles in stagnant waters, covering them with jungle plants, clod of earth or cold dung. When the setting is complete the ryots go into the water waist deep, and by thrashing the surface of the water with the stalks assist the loosening of the bark with the fingers, the fibers are separated from the bark. Afterward it is wrung out and hung on lines to dry. It is then made into drums of 70 - 80 pounds. It is next pressed into bales of three hundred pounds for exportation. Little may be said of jute culture in this country. At the low prices that prevail for imported jute, it is doubtful if it could be made a paying crop. The plant is adapted to be raised in the United States and could produce a superb fiber, but it would not be able to compete with India jute at one and one-half to two and one-half cents per pound.

The manufacture of jute was practically unknown to Europe and America a hundred years ago, but jute fiber has been used in India for centuries in the making of cord, twine, and various coarse fabrics. For an indefinite period these fabrics were produced in India by hand looms. Machine manufacture began in 1822 when some fiber was sent to Dundee, Scotland -- now the western home of the jute industry. At that time, Dundee was a comparatively important textile center, spinning and weaving flax and hemp; and the same kind of plant and equipment could be used in the manufacture of this longer and coarser fiber.

Jute is treated by processes similar to those employed in twining flax and hemp. Special machines are used for the various processes, such as heckling, spreading, drawing, roving, and spinning. Since 1857 a great many jute mills have been fitted with modern machinery. There are seventy-five such mills in India employing over 260,000 persons. The production of fiber is 4,215,000,000 pounds annually. The British finally directed attention to the possibility of manufacturing jute goods in India, and in the year 1858 a small consignment of machinery was dispatched for Calcutta.

Development of the industry was slow because of the difficulties encountered in inducing the natives to remain inside of the factories during the period of training. In addition, it was difficult to keep the trained operatives constantly employed. In spite of these handicaps, however, the jute industry expanded, until it reached second place in Indian exports.

(1929)



Uses of Jute Fiber. Uses of the fiber are many, and it enters into all classes of textiles from woven fabrics of great beauty to coarse ropes and bagging. In the manufacture of fabrics it goes into curtains, chair coverings, upholstery, carpets, webbing, and burlap. It has been used to imitate fabrics, like silk, although for this purpose the fiber requires a special treatment in order to subdivide it more finely and render it more glossy.

The fiber is also made into all kinds of cordage, either honestly as jute, or as an adulterant, great quantities being used for binder's twine. It is used for fine and coarse twines, small rope, sash cords, and where cheapness is a deciding factor it fills the demand. In 1929, the United States imported 87,819 long tons of jute and jute butts, valued at \$11,272,000. Burlaps were imported to value \$77,377,000, and other jute fabrics to value \$6,345,000. In 1927 there were 23 establishments manufacturing jute products in the United States. These employed 5,358 hands and turned out products valued at \$23,186,000 annually. (Special Report #8 Office Fibre Investigation, Dept. Agriculture.)

At present, Dundee exports large quantities of gunny sacks to the coffee districts of Brazil, to the wool producing areas of Australia, to the sugar fields of Cuba, and to the quebracho area of Gran Chaco, South America. For a long time India exported raw jute and only a little of the finished product, such as gunny sacks and cloth. The United States uses hundreds of millions of yards of this cloth yearly for linoleum, grain bags, potato bags, and wrappings for cotton bales. The meat packing houses use it to cover racks of beef and lamb.

Malvaceae

Nearly all members of Malvaceae yield bast fibers that can be used for textile purposes as:-

1) China Jute or Indian Mallow (*Abutilon Avicennae*). This plant is an annual and gives strong, coarse, grey-white, lustrous fibers and has the same uses and characteristics as jute has. It grows well in China and thrives in the United States. (Hill's Botany, p. 37.) In many places it is a troublesome weed. The fibers take dyes readily and are used in rug-weaving in China.

2) Deccan or Garbo Hemp (*Hibiscus cannabinus*) is a native shrub of the East Indies, Nigeria, and India and other countries. It is raised for its fiber and is used as a hemp and jute substitute in making canvas and cordage. Great Britain imports a considerable amount of this fiber.

3) Roselle or Rama (*Hibiscus Sabdariffa*) is an African plant that has been introduced into the Philippines and other tropical countries. It grows rapidly and gives a strong, silky light-brown fiber. It is a good substitute for jute in the textile and paper industries.

4) Aramina (*Urena lobata*) grows as a weed in all tropical countries. It gives a yellow-white fiber that is more lasting than jute and is used as a substitute for it in the industries. It is grown commercially in Cuba, Madagascar, and Brazil and the fibers are woven into coffee sacks.

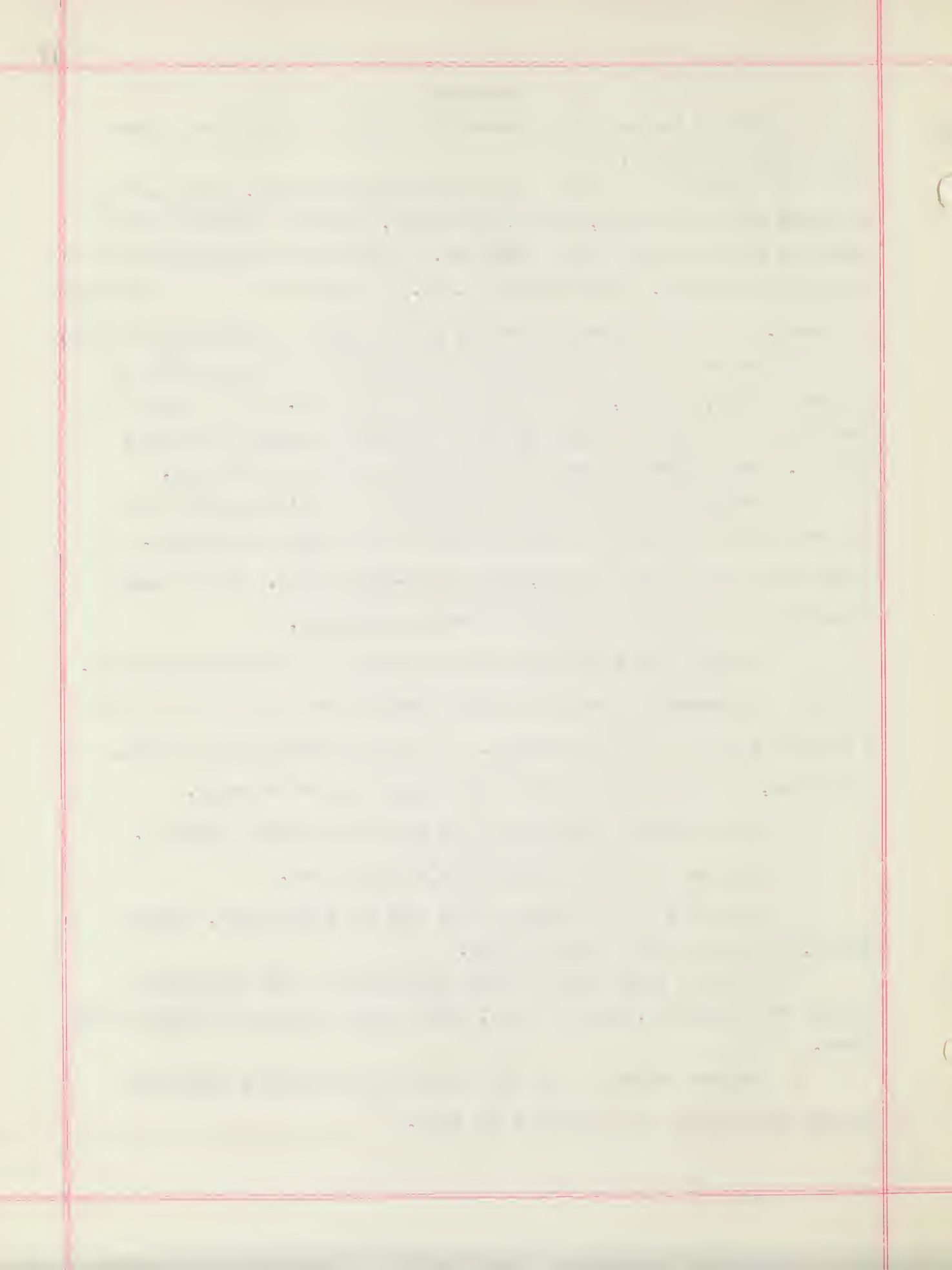
5) Okra (*Hibiscus esculentus*) is a minor fiber used in weaving.

6) Rajugua (*Hibiscus tiliaceus*) is a minor fiber.

7) Cuba jute (*Sida rhombifolia*) is used in bagging cane, tobacco leaves, and packing about tobacco boxes.

8) Colorado River Hemp (*Sesbania exaltata*) was used by American Indians for bowstrings, nets and ties. These fibers come from the bast of the plant.

9) Eastern Indians of the United States used *Apocynum cannabinum* (Indian hemp) fibers for bowstrings and ties.



C. Hard or Structural Fibers

1. Coir: Coconut Fiber

Coir is the coarse, short, rough fibers of the husk of the fruits of the coconut palm (*Cocosnucifera*). Coir fibers may be obtained ten inches long, and are the only prominent fibers that are obtained from fruits. The best grades of coir are the straight fibers. "The coconut fruit within the fiber wrapping is a large, rather three-sided, dry drupe, or a one-seeded stone fruit. The outer smooth rind of the husk is the epicarp, the fibrous portion within is the mesocarp, while the hard stony outer part as seen in markets is the endocarp". (Robbins' Plants Useful to Man, pages 101-104.) The coconut tree itself grows one hundred feet high and two feet in diameter. The fruits are borne at the top of the tree.

The coconut palm is widely distributed near sea shores throughout the entire tropical world. All its near relatives grow in South America in the Amazon region, and the tree is native to the Malay Archipelago.. Early mariners or ocean currents may have carried it from one place to another. Salt water immersion does not destroy the germinating power of the seed. In former times there were no large plantations for this fruit, but today there are many on the Pacific Islands, the Philippines, Ceylon, and Dutch East Indies, South America, Africa and India. Hot tropical climate and abundant rainfall are necessary ^{for the coconut's growth.} The coconut is extremely sensitive to cold and will not grow where frosts exist. Many varieties have been introduced from Asia and ^{the} East Indies to Florida and are being raised in the warmest portions. Only two per cent of coconut yield grow in tropical America.

THE [illegible] OF [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

The culture of coconuts is by seed. The mature, unhusked nuts are placed on their sides and partially covered. They germinate in four to five months in moist soil, fruiting begins in the fifth year and full bearing is reached at twenty years. Seventy to eighty trees are raised to an acre for highest nut production, and an annual tree yield is from twenty to two hundred nuts. Greatest vigor of growth results from adding fertilizer and organic matter annually, and growing leguminous cover crops.

Unripe coconuts are soaked in salt water for several months to soften the fiber, ^{then} washed, and dried. "In tropical Asia and the South Seas it is the source of sennet braid, which is made into hawsers, cables, and small cordage". (Hill's Botany, p. 44). "This hard, coarse fiber is used for weaving door mats, hall runners, and stair carpeting known as cocoa matting. Coir fibers are superior to all other fibers for cordage because they are light, elastic and resistant to water. Also coarse textiles are woven from it. Curly fibers make excellent stuffing for upholstery, stuffing for bearings of railroad cars, and a good oakum substitute. Fireside brushes are made of coir". (Garden Dictionary, page 155). Splits of the coconut trunk are used for furniture, the leaves are used for thatch and the fibrous shells are used as water containers and dishes in the Orient and tropics.

2. Pineapple: *Ananas comosus*

The leaves of the pineapple (*Ananas comosus*) are numerous, thick, stiff, and spiny. They furnish fibers of great strength and fine qualities. They are shiny white, very durable and flexible, and are not injured by water. "When grown for the fiber, pineapples are planted closer together

and develop longer leaves. They are propagated by suckers which develop abundantly. To be of value, the fibers must be taken from the leaves not fully matured. Usually two year old leaves are cut and the fibers scraped out by hand, a delicate and expensive process. After being dried and combed out, the fibers are tied end to end and are woven. In the Philippine Islands pina cloth, one of the most delicate and costly of fabrics, is made from the fibers. Formosa and China also utilize pineapple fiber in making strong fabrics." (Hill's Botany, p. 45, and International Encycl.p.2720).

Pineapple fiber is a native of northern South America, around the the Orinoco and Amazon basins but it was carried by Spaniards and Portuguese to the Old World, and spread all over tropical Asia, Africa, East Indies and Polynesia. "The waste products are all utilized in one way or other. Hawaii produces seventy-five per cent of the world crop. Cuba, Puerto Rico and Central America supply the United States with most of its fiber. Borneo and the Malay States also produce fiber types and supply Europe and the East". (Robbins'"Plants Useful to Man", p. 301).

The *Ananas sativa*'s fleshy leaves are cultivated in the Philippines, and the fibers are used for weaving remarkably fine dress fabrics as

jusi cloth . Similar fibers are used in a small way in Taiwan (Formosa) Borneo, and in the South Pacific Islands. "In southern Mexico a pineapple fiber *Ananas macrodontes* is known as pita floja. Great quantities of wild plants similar to the pineapple grow in warm countries giving fibers excellent for weaving, being fine, strong, and lustrous, seeming to rival silk or linen", (Toothaker's, "Raw Materials", p. 122) and only used locally in those countries.

3. New Zealand Hemp

The fibers are taken from the long, fleshy leaves of *Phormium tenax*, an iris-like plant in the Liliaceae. "The fibers are softer and more flexible than abaca, and have a higher luster. New Zealand Hemp is the only important hard fiber plant of temperate countries." (Hill's Botany, p. 42). It is a native of the swampy regions of New Zealand, but is also raised successfully throughout the tropics, and in the warmer temperate regions. It has been introduced into California for ornamental and commercial purposes.

The long and costly sea voyage to Europe has made it necessary for New Zealand to specialize "in concentrated products for export so their hemp is manufactured at home into cloth, cordage, ship cables and twines. The refuse is fed to the beef cattle". (Whitbeck's Geography, p. 530-532.)

4. Bowstring Hemp

The leaves of *Sanseveiria*, Liliaceae, yield strong, white, elastic fibers of bowstring hemp, which have long been in use by native peoples. *Sansevierias* are herbaceous perennials, with basal rosettes of sword-like leaves arising from a creeping rootstalk. Several species occur as wild plants in various parts of tropical Asia and Africa. The Hindus have grown bowstring hemp for years. Wild and cultivated species are used. The important species are *S. thyrsiflora* which grows in Jamaica, Central America and tropical Africa. *S. Roxburghiana* grows in India and *S. zeylanica* grows in Ceylon and other islands in the tropics. *S. longifolia* grows in the United States, especially in Florida. *S. guineensis* grows in Africa and is a bowstring hemp fiber. The fibers are removed by hand or machine.

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

... and the ... of the ...

"Bowstring fiber is woven into mats, hammocks, bowstrings, crude ropes and twines". (Hill's Botany, page 43.)

5. Agave Fibers: Amaryllidaceae

Agaves are decorative and economic plants from hot, American deserts, the most familiar of which is *A. americano*, the Century Plant or American aloe. "The agaves are stemless, perennials, with basal rosettes, usually stiff and more or less fleshy, persisting from year to year, the margins are mostly armed with teeth and the apex tipped with a usually pungent spine; the flowers are arranged in spikes (*Littaea*) or panicles (*Eugave*), the perianth is six-parted, more or less funnel shaped; stamens six mostly long exserted; one style; ovary is inferior and has three cells; the seeds are numerous, flat, thin and black". (Bailey's "Cyclopedia of Horticulture" page 230, Vol.I.)

Some species flower but once and die, others occasionally, while others flower from year to year. The number of species is three hundred and the majority of them have been described. The leaves of all species give fibers useful to man. Most of this number come from the Mexican table-land. "The fiber is cleaned by scraping away the pulp by hand or by machinery. Fiber is raised for rope, bagging, brushes, and hammocks". (Toothaker's , p. 119). The product is called by many names, according to the locality and the variety of the plant which produces it; as henequen, sisal, maguey, lechuguilla, ixtle, pita, yaxci, zapupe and hemp. The name is loosely applied by the natives, the same fiber being called by different names in different places.

Henequen or Yucatan Sisal

Henequen is a desert plant that thrives in an arid environment where the average annual rainfall of thirty-five inches or less, is too scanty to supply moisture needed for other crops. It belongs to the *Agave fourcroydes*, *Amaryllidaceae* group. The fiber comes from the leaves which bear spines. The fiber is light straw color, hard, wiry, elastic, and measures three to five feet long. Its merits are its length and strength.

It has been cultivated for centuries in the drier parts of Central America, particularly long ago by the Aztecs in Yucatan. In this region climate, drainage, and soil combine to cause the dry conditions. Rapid evaporation of moisture under the intense heat of the tropical sun, and seepage into the thin stony soil and on into the underground channels of the soft limestone rock drain water from the surface. "Tampico, Yucatan, is the center of large production areas of this fiber. Mexico raises 100,000 tons; East Africa, 70,000 tons, Dutch East Indies, 50,000 tons; Cuba, 5,000 tons; and Jamaica and Bahamas 2,000 tons; other places raise 4,000 tons." (Whitbeck's Economic Geography, p. 273).

The fibers are scraped out from the leaf tissues and great care is needed to avoid jabs from the spines on the edge of the leaves. Its present importance dates from the Spanish American War, when the export of Manila hemp was cut off, henequen was exported to the United States, the largest market for cordage fibers in the world. "Today henequen meets the ever increasing demand for binder twines, and supplies eighty per cent or more of the raw fiber used in the manufacture of that commodity in the United States." (Case and Bergsmark's College Geography, p. 209). The

plantations of henequen in the peninsula of Yucatan cover thousands of acres and the yearly value of sisal exported reaches fifteen millions of dollars. It is also used for lariats, and used to tie up cattle for branding and sheep for shearing.

6. Sisal: *Agave sisalana*

Sisal resembles henequen, but lacks the spines on the leaves. The leaves of the plant, *Agave sisalana*, *Amaryllidaceae*, give the fibers for commerce. The fibers are white, cleaner, and lighter than jute, and in strength rank next to the best quality of Manila hemp. They are also coarse and stiff.

Sisal is a native of Central America and Mexico, but it is now cultivated in Hawaii, in the East and West Indies, in sections of Africa, especially the British possessions. The plant is drought resistant, and will grow where other species fail - little cultivation is necessary. Mexico, and the Dutch East Indies supply the United States with tons of this fiber.

Preparation of the fibers is by hand, or by the use of a "raspador". "The fibers are pulled from the pulp of the leaf, washed, dried, and packed in six hundred pound bales for shipment". (Hill's Botany, p. 41.) The essential feature in the economic production of sisal agave is adequate machinery to separate the fibers from the leaf pulp. Sisal fibers are manufactured into grain-sacks and into twine for use on the self-binding harvesters". (Redway's Commercial Geography, page 122.)

7. Istle, or Ixtle, or Tampico Fiber

Several fibers have been used in Mexico from prehistoric times under the above names, istle, ixtle, or Tampico fiber. Three kinds of istle are recognized from Agave, Amaryllidaceae:

1. Jaumave istle from Agave heteracantha
2. Tula istle from A. Lecheguilla
3. Palma istle from various species of Yucca.

"The fibers are obtained from immature leaves, and although they are shorter than sisal and henequen, they are stronger, stiff, harsh, and durable". (Hill's Botany, p. 41). Istle fiber grows to twenty inches from plants with smaller leaves.

Some yucca are cultivated for ornamental purposes. They are non-cotyledonous and the inflorescence is an aggregate of small white bells hanging from the flower spike. "Yucca grow in sand or arid places in Mexico, the United States, and south through the drier regions and on hillsides of Central America, and hold the soil in place." (Robbins' "Plants Useful to Man", pages 112-113.)

These istle fibers are used to prepare a substitute for curled hair in mattresses and in upholstery. (Toothaker's "Raw Materials", p.120).
One sacks made of istle are known to have lasted ten years.^{They} are in use in the mining regions of Chile, Peru and Central America. Their stiffness and harshness make the fibers good for brushes.

8. Maguey (Agave Cantala)

Maguey fiber comes from Agave Cantala, Amaryllidaceae plant native to India, Java, and cultivated in the Philippine Islands. Stronger fibers are produced from cultivated plants than from wild plants. The fibers average from three to four feet in length, are strong, and are a good substitute for sisal.

"Mexican Maguey fibers are used locally and are woven into coarse garments and covers," (Toothaker's , p. 120) and are seldom exported. Bombay aloe and Java Maguey are similar and do not enter the export trade in any quantity. String, twine and coarse wrappings are made of it in the Orient. The United States and Great Britain are the customers for this fiber for twine.

9. Mauritius Hemp

Mauritius Hemp is obtained from the green aloe leaves of *Eurcraea gigantea*, Amaryllidaceae. The plant has a tall flowering stalk and less rigid leaves than others. The peduncle is often referred to as a "pole" and reaches twenty to forty feet in height. The fibers are long, white, soft, and elastic, but are weaker than sisal.

Mauritius hemp is a native of tropical America and is raised throughout the tropics of both hemispheres giving fiber for domestic purposes. "It is raised in abundance on Mauritius and Saint Helena for export", (Will's Botany, page 42.) The fibers are made into hammocks, bags, coarse twine, and cords of various weights.

Furcraea foetida, *Amaryllidaceae*, has valuable leaves, fleshy, filled with structural fibers useful to man. It grows in the West Indies, and Mauritius, and is exported for rope-making. It is believed to be native to eastern Brazil where it is found growing wild. *Furcraea cabuya* fiber is a Central American sisal. The fibers are long and strong and are native to Costa Rica. They are used locally within the country for rope and twine. Cuban hemp (*Furcraea hexapetala*) used to tie cigars, and woven for bagging. Venezuelan cocuiza is a cord fiber, and woven into a cheap fabric, for home use.

Hard or Structural Fibers

Abaca (*Musa textilis*) yields Manila hemp. It grows twenty feet high; its leaves are two feet long and are tufted. The stalks contain the finest cordage fiber in the world (Manila hemp). The plant has a drooping flower spike. Several species of wild plantain or banana give fiber from the sheathing leaf stalks. "The fibers vary in color from white to reddish yellow, and are light, stiff, and lustrous. They represent structural elements, sclerenchyma cells, and are removed from the leaves by hand- and a slow laborious process." (Hill's Botany, p. 39.) The fibers are elastic, strong, pliable, and smooth, and vary from six to twelve inches in length. They also have gloss and brilliancy.

Musa textilis is cultivated in the Philippines, in India, and in all the islands between. It grows well in a warm humid climate where the soil is rich, and well-drained.

When all the pulp is scraped by hand from abaca, Filipino and Chinese labor prepare the fiber for commerce. A raspador is used to remove the

Hemp is coarse, stiff, light yellow fibers. The short fibers are beaten and heckled in the same way as flax, until fine enough to weave into mats, carpets and cloth.

"The chief use of abaca is in the manufacture of cordage, marine cables, binder twine, bagging, paper mache, wrapping paper, hats, and a lustrous cloth known as sinamay cloth is woven from the fiber". (Garden Dictionary, p. 514). Abaca fiber is woven into sailcloth in the Orient. By fermenting the fibers in Asia, an intoxicating drink is prepared. Ravelings and small pieces are used as oakum for caulking vessels. The fibers that have served their usefulness as rope are pulped and made into manila or yellow paper. The manufacture of cordage and paper is done mainly in the United States and Great Britain. 200,000 tons of abaca are raised annually, which make up three-fourths of the total exports from the islands.

Fibers in Rope-Making

The Egyptian workmen made ropes from Papyrus and palm fibers of which specimens still exist. Only by the use of large and strong ropes could they have moved the massive stones that can be seen in their pyramids and temples.

When men began to move boats by sails, ropes of some kind were needed, and these early ships demanded long and strong cordage. There are pictures of these ships several centuries before the Christian era. Herodotus wrote that Xerxes built a bridge of boats across the Hellespont 480 B.C. and fastened them together by enormous cables which stretched from shore to shore, a distance of nearly a mile. These ropes were nine inches thick and made of Papyrus.

During the medieval and later centuries, rope-making was an active industry and America was not long settled before John Harrison, an English expert in this line, set up a rope-walk in Boston in 1641 and held a monopoly of the trade. After his death, the art became common and in 1794 there were fourteen large ropewalks in Boston. In 1810 there were 173 of these industries in the United States. The business has grown and prospered.

In the period referred to, all the work was done by hand, machine spinning being of later date. American hemp was used, this softer fiber was spun by hand long after Manila hemp was spun by machines. The hand-making process, long used is an interesting one. The first step was to "hackle" the hemp. The hackle was a board with long, sharp steel teeth set in it. This combed out the matted tow of the hemp into clean, straight fiber.

The instrument used in spinning was a large wheel, turned by hand, it set in motion a set of "whirls" or revolving spindles, which twisted the hemp by their motion. The spinner wrapped a quantity of the hackled hemp around his waist, and attached some of the fibers to the whirls which twisted the hemp, as he walked backward down the ropewalk, pulling out new fibers from his waist one by one and pressing it into form and size with the fingers of the other hand.

In forming a small rope, tow of the yarns thus formed were twisted together in a direction opposite to that of the first twist. When a second twisting followed, the direction was again reversed. Horse or water power was used when the ropes became too large to be made by hand.

The early type of machine, for spinning rope yarn, was made by Thomas Barraclough of Manchester, England. It gave way to a four strand compound laying machine making strands and laying rope in a single continuous operation. Sixteen inch towlines are made with an eye splice and the first breafter forms the slivers for spinning.

Machine Made Ropes. The large ropewalk today is largely obsolete. The rope-making machine has replaced the hand-making process, which was not adapted to produce the large cables which the times demand. Steam driven machines were introduced in 1838. These are capable of making fine threads, yarns, or large ropes.

There are two methods used in modern rope-making. In one, the strands are formed on one type of machine and twisted into a rope on another. In the second method, both operations are performed on a single machine. The former is better fitted for large ropes.

Factories were built for the two-part method. It comprises two or more horizontal strand-forming machines, several bobbin frames, and a vertical laying machine. The former twists several strands into a rope, the latter several ropes into a cable. The fiber yarns which are wound around bobbins, are drawn from them through perforated plates, and these are so placed that the yarns converge together and pass into a tube. Then they are compressed, twisted, and wound on reels for the second laying process. Next the fibers go into a machine where they are twisted into a rope. Then they proceed to a belt-driven coiling reel on which the rope is wound.

II. Brush Fibers

Small stems and twigs and stiff roots are utilized in the manufacture of brushes, whisks and brooms. Such fibers must be strong and elastic. In some cases, whole twigs, fine stems, or roots are used and in others fibers are obtained from leaf stalks. "Brush fibers are those too stiff for spinning". (Toothaker, "Raw Materials", page 104)

A brush is an instrument made of bristles set in a back or handle and used for various purposes. Brushes used for cleaning have stiff fibers, as palm fiber. Soft brushes are often made from animal fiber as camel's hair. "Large brushes are made by boring small holes at regular intervals in a piece of wood, inserting the fiber in these holes, and fastening it in by wire". (Sourcebook Encyclopedia, Vol. I, page 401). A finishing piece of wood is then glued, forming the back and usually the handle, then the fibers are cut to an equal length.

English broom fiber comes from a shrub *Sarothamnus* (*Cytisus scoparius*). Butchers' brooms are made from liliaceae, ruscus, and *Ruscus aculeatus*. Irish broom fibers are made from *Sarothamnus patens*, which grows in Spain and Portugal. (Standard American Encyclopedia, Vol. III). "European broom, a member of the pea family, grows in the Mediterranean where many species of it are known as besoms - the branches are made into twig brushes". (Sourcebook Encyclopedia, p. 394).

Bamboo Splits

Bamboo Splits: come from *Arundinaria*, *Bambusa* and other ^{bamboo species} a giant grass with a woody stem which reaches a foot in diameter, and one hundred feet in height, the *Dendrocalamus* of Ceylon is an example. Bamboos grow in clumps along waterways and in low monsoon areas of Eastern Asia. The stems are

The first part of the paper discusses the importance of the study and the objectives of the research. It highlights the need for a comprehensive understanding of the subject matter and the role of the researcher in this process. The second part of the paper presents the methodology used in the study, including the selection of participants, the data collection methods, and the analysis techniques. The third part of the paper discusses the results of the study and the conclusions drawn from the data. The final part of the paper provides a summary of the findings and offers suggestions for future research.

The study was conducted in a laboratory setting and involved a group of participants who were selected based on specific criteria. The data was collected using a series of questionnaires and interviews, and the results were analyzed using statistical methods. The findings of the study indicate that there is a significant relationship between the variables being studied, and this relationship is supported by the data collected. The conclusions drawn from the study suggest that the findings have important implications for the field of research, and further research is needed to explore these findings in more detail.

In conclusion, the study has provided valuable insights into the subject matter and has identified areas for further research. The findings of the study are consistent with previous research in the field, and the methodology used in the study was found to be effective in collecting and analyzing the data. The study has also identified some limitations and suggests ways in which these limitations can be addressed in future research.

divided into coarse and fine splits for grass rakes, stable and weed brushes.

Broomroot

Broomroot comes from a grass, *Epicampes macroura*. The grass has tufted wiry culms, and coarse roots. It belongs to Gramineae. It is a perennial. It is often referred to as rice root and grows in the highlands of Texas, Mexico, and elsewhere in Central America. The roots are the plant part used. They are dug up in any season of the year by peons (Hill's-page 48) washed, cleaned, and dried, and the tops removed. They are then graded as to quality, length, and color and baled for shipment. They are used in the manufacture of cheap brushes.

Broomcorn

Broomcorn comes from *Sorghum vulgare* variety *technicum*. It is a stout grass ten to fifteen feet high and it is grown for the very stiff branches of its large flowering cluster. "These rigid, stiff, slightly twisted branches grow eighteen to thirty inches long in the largest sorts, and twelve to twenty inches in the smaller varieties". (Garden Dictionary, page 362.)

In the United States it is grown in the Mississippi valley, Oklahoma, Illinois and Kansas. It is harvested before the flowering season is over and the stems are cut a few inches below the head. The heads are sorted, threshed, and dried, the largest heads are made into carpet brooms and smaller heads are made into brushes and whisk brooms.

Holcus sudanensis, Sudan grass, is native to Africa. It is an annual grass and clumps are tied together for hearth brooms.

The United States exports annually quantities of dried brush to Europe for broom manufacture.

Wheat Straw

Wheat is an annual grass, belonging to the genus *Triticum* which comprises eight wild and cultivated species. Cultivated wheat, *T. aestivum*, grows to a height of two to four feet. The wheat stalks give valuable wheat straw which excels all other kinds because of its great strength. (Mill's - p. 321). Wheat grows in moderately dry temperate climates, with a growing season of ninety days and an annual rainfall of more than nine inches. Wheat growing areas are the plains of southern Russia and the Danube, Mediterranean countries, Northwestern Europe, the central plains of the United States, Canada, Columbia River basin, Northwest India, Argentina, and Southwestern Australia.

Wheat is sown broadcast, either by hand or by sowing machines. Cultivation and weeding follow. The harvesting is done by simple reaping hooks, scythes, or reaping machines to cut the culms; and binding machines bind them into sheaves. The wheat is housed, dried, the stalks are flailed, and the combines finally bind the straw. Wheat straw is made into brushes, string, plaited into thatching, and woven into straw wicker carriages.

Brazilian Piassava

Brazilian piassava comes from two species of palm. *Attalea funifera* gives Bahia piassava fiber. The fibers are stiff, wiry, brown, and bristle-like. An axe or hatchet is needed to remove the fibers from the swollen bases of the leaf stalks. The *Attalea* species of palms grow everywhere in the lowlands of the Amazon and Orinoco river regions. They are made into brushes for street-cleaning machines and for cables. *Leopoldinia Piassaba* gives Para piassava fibers on the margins of the leaf petioles. They are made into brushes and brooms and the natives make ropes and baskets of

them . (Hill: page 43)

Palmyra Fiber

Palmyra Fiber is a coarse fiber obtained from Palmyra palm (*Borassus flabellifer*) of the East Indies. It is one of the most economically important of the palms. All parts of the plant are useful. The fibers are made into rope, twine, paper, and machine brushes.

Kittul Fiber

Kittul Fiber is fine, soft, and pliable and comes from the leaf sheaths of the toddy or fish-tail palm (*Caryota urens*) of Ceylon and the East Indies. The long spikes which flower from the top of the tree to the base are collected and dried for sweeping the inside of the native huts. The black bristles are made into strong ropes, or into soft brushes, and they are a good oakum and horsehair substitute.

Coir and Coconut Leaves

Coir, comes from Coconut husks, *Cocos nucifera*. It gives long, strong fibers which often reach ten inches, for the manufacture of brushes.

The coconut palm, *Cocos nucifera*, is one of the world's most valuable trees. The large pinnate leaves grow six to twelve feet long and eighteen inches wide, (Hill - page 337), and are borne in a cluster at the tip of the stem. This palm thrives best in the tropics, in southern India, Ceylon, Java, Malacca, Malaya, Borneo, Singapore, and the Philippines. It grows near the seashore to an altitude of 2,000 feet.

It is cultivated for its grace, beauty, and products; and tends to have a leaning habit. Dozens of articles are made from the dried leaves,

especially brooms.

Para Piassava

Several species of palms growing in America and Africa are the source of brush fibers known as bass, piassaba or piassava. These trees have leaf stalks or leaf sheaths which yield stiff, coarse brown or black fibers. They are used in making whalebone brooms for stables and street sweeping brushes. "Para piassava fibers are produced on the margins of the leaf petioles of *Leopoldinia Piassaba*". (Hill - page 46) They are used for brushes and brooms by the natives.

West African piassava, (*Raphia vinifera*), comes from the fibrous sheaths which grow around the leaf stalks. The fibers resemble raffia. The fibers vary in diameter from one thirtieth of an inch to one sixteenth of an inch. *R. vinifera* grows in tidal bayous and creeks of Liberia and in other countries on the west coast of Africa. The leaf stalks are retted and the bundles beaten out. The long fibers are made into mats and brushes. (Hill - page 45.)

Palmetto

The palmetto fiber comes from the unbranched *Serenoa serrulata*, of the palm family. The leaf stalks and creeping stems (commonly called the roots) are collected for their fiber. Tangled fibers are removed from straight fiber and it closely resembles coir. It is wild in the Gulf States, (Toothaker's, page 123), but it grows in tropical and subtropical countries, the West Indies, Venezuela and Mexico.

Palmetto fiber makes excellent "scrubbing brushes, hats, matting and canes." (Sourcebook, p. 2149)

Istle

Istle fibers come from Agave Lecheguilla and vary in length from two to eighteen inches. "They are taken from immature leaves and these fibers are strong, durable, stiff, and harsh. Much of the fiber comes from northeastern Mexico". (Toothaker's - page 120.) Istle fibers are manufactured into a variety of brushes. The United States imported eighty-seven hundred and forty-seven tons of istle in 1955, (Hill, page 61) for whisks and brooms.

Some of the trees give wood for the backs and handles of brushes. The reddish brown sycamore (*Platanus occidentalis*), the white, close-grained holly (*Ilex opaca*), the dark purple rosewood (*Dalbergia nigra*), the smooth and lustrous West Indies satinwood (*Zanthoxylum flavum*), the olive wood (*Olea europea*), are used in the manufacture of brooms and brushes.

III. Plaiting and Rough Weaving Fibers

Fibers which are used for plaits are flat, pliable, strands which are interlaced to make straw hats, sandals, baskets, chair seats, and the like. More elastic strands are roughly woven together for mattings and the thatch-roofs of houses, while twigs or woody fibers are used for baskets, chairs, and other forms of wickerwork. "Only a few of the materials used for plaited or coarsely woven articles are of commercial importance, the greater number is used in native manufactures." (Hill, page 48).

The raw materials comprise the stems of:

Reeds	Willows
Bushes	Bamboo
Grasses	Rattan
Other Plants	

THEORY

The first part of the theory is the definition of the function $f(x)$. The function $f(x)$ is defined as the function which satisfies the following conditions:

- (1) $f(x)$ is a continuous function of x .
- (2) $f(x)$ is a function of x which is defined for all values of x .
- (3) $f(x)$ is a function of x which is defined for all values of x .

The second part of the theory is the definition of the function $F(x)$. The function $F(x)$ is defined as the function which satisfies the following conditions:

- (1) $F(x)$ is a continuous function of x .
- (2) $F(x)$ is a function of x which is defined for all values of x .
- (3) $F(x)$ is a function of x which is defined for all values of x .

The third part of the theory is the definition of the function $G(x)$. The function $G(x)$ is defined as the function which satisfies the following conditions:

- (1) $G(x)$ is a continuous function of x .
- (2) $G(x)$ is a function of x which is defined for all values of x .
- (3) $G(x)$ is a function of x which is defined for all values of x .

The fourth part of the theory is the definition of the function $H(x)$. The function $H(x)$ is defined as the function which satisfies the following conditions:

- (1) $H(x)$ is a continuous function of x .
- (2) $H(x)$ is a function of x which is defined for all values of x .
- (3) $H(x)$ is a function of x which is defined for all values of x .

The fifth part of the theory is the definition of the function $I(x)$. The function $I(x)$ is defined as the function which satisfies the following conditions:

- (1) $I(x)$ is a continuous function of x .
- (2) $I(x)$ is a function of x which is defined for all values of x .
- (3) $I(x)$ is a function of x which is defined for all values of x .

The leaves of:

1. Pandanus: Pandanaceae
2. Raffia: Raphia podunculata
3. Puerto Rico Palm: Sabal causiarum
4. Panama Hat Palm: Carludovica

1. Pandanus Hat Straw

The leaves of the Pandanus, or screw pine, are long "sword-like, and acute commonly sharp-dentate, or prickly on the margin and midrib". (Bailey's Horticulture, page 2449). Pandanus comprise small trees or shrubs, erect, or rarely prostrate, and usually forked. The trunk is annular, long and ringed. It often produces aerial stilt-like roots and reaches tree height. These plants have their leaves arranged spirally at the top of the tree. They grow in the South Sea Islands, Malay, Ceylon, India, Africa, and the islands of the Indian and Pacific Oceans.

P. litoralis grows to a height of twenty feet, the much branching trunk is aerial and supported by aerial roots. The leaves are three to five feet long, linear, lanceolate, and valuable, whole or stripped. It grows in Southeastern Asia and Oceania in tidal streams and near the sea in the Philippines. The tree is monocotyledonous and sun hats are made from the fibers.

In the tropics *Pandanus utilis* is a valuable plant to man. It grows sixty feet high in Madagascar. It is an ornamental plant in parks or about buildings and is at home in palm-houses. It should be treated as a semi-aquatic plant in Victoria tanks. *Utilis* requires much heat and plenty of water. Pandanus straws are used for making hats in Formosa, Japan, Siam and the Philippines.

Culture: They are propagated from suckers that are produced from the main stem. They are removed with a few of the bottom leaves, in January, and planted in wet loam and peat moss.

The main use of the leaves is the fiber for hat-making. *P. Baptistii* grows leaves an inch wide with yellow and white stripes and a short stem. It is native to New Britain Isle for fibers for hats. *P. pacificus* has broad and dark green leaves, shiny, abruptly narrowed to a tail-like apex and its margins have small fine spines. The leaves are stripped for their fibers and woven into sun-hats. (Bailey's Horticulture, Pandanus)

III. Straws: Graminaceae

Wheat straws are the dried stalks of the grains, grasses, sedges, and some rush. Plants are grown close together so few leaves will develop and the stems will grow tall. They are harvested before maturity. (Hill, p.48). In wheat, the stems are split lengthwise, rolled flat with a wooden spool, and dried before plaiting. The Leghorn and Tuscan hat straws are made from bearded wheat of Tuscany, Italy.

Rice straws are the stalks of *Oryza sativa*. There are thirty-four hundred varieties raised in the world - some occur as wild plants and some are cultivated. Rice is an annual grass growing two to four feet in height. It grows best on damp soil at the delta or flood plains of the monsoon region. It is native to Southeastern Asia; China, Japan, India and Java produce the greatest quantity of stalks for man's use.

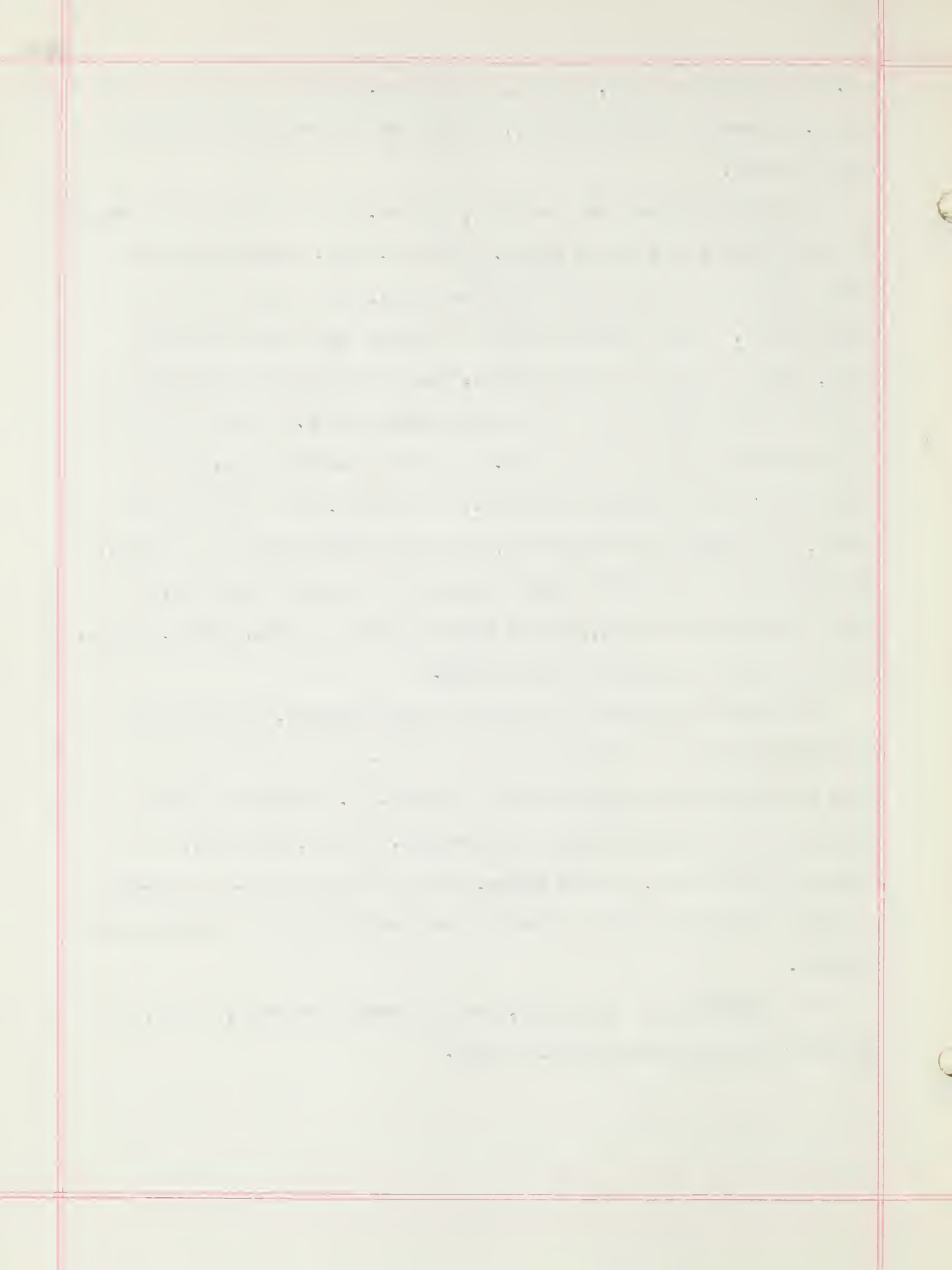
Lowland rice which has to be flooded during part of its growth is raised almost exclusively. The fields are plowed and the rice is sown broadcast or six-inch plants are transplanted from beds. The young plants are covered with water until ripening starts, then the fields are allowed to dry

out. The stalks are dried, pressed, and plaited, ready for sandals and hat making. Hat-making in China, Japan, and the East Indies uses tons of rice straw annually.

Barley straw comes from the plant, *Hordeum*. "It is an Old World Species Cultivated Over Four Thousand Years". (Hill, p. 298). Vavilov stated in 1926, "barley was derived from Southwestern Asia, North Africa and Southeastern Asia". Barley was also native to Central Asia and available to Egypt, Greece and Rome at an early date, where the Romans held festivals at seed time and brought barley to honor the goddess Ceres. Barley grows well in the northern regions of the world. It grows three feet high; it is an annual which tends to become perennial. It is hardy, has a short growing season, and grows at great altitudes, as eleven thousand feet in the Andes, and seventy-five hundred feet above sea level in the Rocky Mountains. The stalks are valuable for hay, and the straw is used in Russia, France, Turkey, and California for plaiting and hat making.

Rye straw is made from the stalks of *Secale cereale*. The stalks are slender and tough and reach a height of six feet. It is native to the Black and Caspian Sea region of Central Eurasia. *S. montanum* is a wild species and grows in Afghanistan and Turkestan. (Hill, page 336). It will grow on poor soil, in arid places, and at high altitudes. Ninety-six per cent of the world crop is raised and consumed in Europe - Russia's output is first.

The stalks are hay for cattle, and the straw is valuable, strong, and made into various straw products, as hats.



3. Raffia Braids

Hats made of braided raffia are continental hats, colonial, Puritan, sombrero, Dutch farmers hats, Panama, Coolie, the Chinese, outing hat, poke bonnets, army styles. Various colors are used and pretty effects are produced. "Firmness of weave, solidity of the hat, neatness in sewing plaits together, harmony of color where it is used, and good shape are to be desired." (James, page 50.)

Wood shavings of Salix: willow, are made into hat braids in Japan and Central Europe.

4. Puerto Rican Hat Palm

The fiber for Puerto Rican Hats is *sabal causiarum*. The leaves are collected for hatmaking. Bandits and lawbreakers are taught hat making when under army or prison discipline.

5. Panama Hat Palm

Panama palm fiber comes from ~~the~~ jipijapa or *Carludovica palmata*. The plant is a stemless palm and the fiber is resistant to water. The young leaves are collected by natives, split into thin pieces, cleaned, bleached, and woven by hand. The species grows wild in parts of Colombia, Ecuador, of "Northwestern South America, Central America and the West Indies". (Toothaker page 124) in humid forests.

A hat requires six leaves. The fibers of these are woven over wooden blocks or moulds and vary in size from six to ten. They vary in price from fifty cents in Panama to eight and ten dollars in a hat shop in Boston. "Their value rests in the fact that they can be relocked several times without destroying the fiber". (International Encyclopedia, page 2401.)

6. Vegetable Sponge

Vegetable sponge is a unique fiber, obtained from a climbing cucumber, of the *Luffa cylindrica* plant. "The luffas are the cleaned fibrous parts of the ripe fruit of the dishrag vine". (Toothaker, page 126). The fruit is gourd-like and contains a lacy network of stiff curled fibers. "This yellow/^{ish} skeletal material is extracted by retting in water, and is much used in making hats" in Korea and Japan. (Hill, page 54.) Japan exports large amounts of the raw material and hats of the vegetable sponge to Europe and to the United States.

II. B. Baskets and Fibers Used.

Basket making was a common industry of all the Indians of the American Continent. Baskets are made by the Indians from Maine to Virginia, Georgia, to Alaska. There are no savages on earth so rude that they have no form of basketry. Birds and beasts are basket-makers. "Our word basket comes from the Welsh 'basgawd' meaning weaving or pulling together of splinters". (James, page 15). Ancient Welsh or Britons were expert basket makers and the homes of the wealthy Romans were decorated with them.

Choctaw baskets of cane are pointed to the base.

Polynesian baskets are of woven bark.

"Fine baskets to the older Indian women were their religion - their art". (James, page 16).

Old baskets have been found in the Southeastern United States and among the remains of the Mound Builders; in the ruins of Southern Colorado, and in the prehistoric graves of Arizona and New Mexico. Coarse basketry is found charred in very ancient sepulchres. "Women the world over are the basket-makers, netters and weavers" says Otis T. Mason. Indians of the southwestern states are the Navahoes, Hopi, Hauvasupais, Wallapais, and Mission Indians. The Mescalero, White Mountain and other Apaches, Pimas, Papagoes, Maricopas live east of the Rockies. The mid-Californian Indians are Monos, Yokuts and Tulares. The Inyos live around the Colorado River and these tribes are the basket makers of the West. The Tlinkets of Alaska and Haidas of Dall and Prince of Wales Islands make and plait baskets.

The Hauvasupai Indians of Arizona lined their wicker baskets with clay in which they cook seeds, mush, and meat.

California tribes make a baby basket of the chrysalis pattern, and the cradle of Nevada Utes differs by having a woven canopy at the head end protrude.

The Hopis and Navahoes make a square carrying basket and large water bottle baskets. "Hopi flat baskets are made of woven yucca". (James, page 26.)

The Apache women carry water in a basket bottle and Pima women carry loads of vegetables in conical baskets, and pound acorns in oval basket tops.

The Hauvasupais are excellent basket makers and excel in their art.

Sacred baskets for blessing grain and offering sacrifices are made by Navahoes, Pimas, and Apaches. The Yokuts make beautiful baskets for the dance. The Mohonino baskets are used as a vat to make charm liquid. A Hopi sacred meal plaque is made of finely coiled Yucca.

A Soboba Indian basket maker of southern California weaves geometric patterns in color in his baskets. "The finest and most delicate weaving of baskets is done by Aleut Indians of Attu Island in the most westerly part of Alaska". (James, page 50).

Basketry is "a craft of great utility". (Hall, page 5.)

Woven baskets: Reed: Work-scrap baskets

Maple splints

Rush

Corn husks

Round or Oblong baskets, borders

Melon-shaped baskets, jardinières; made by Kentucky mountaineers and Canadians.

Reed Baskets are: Potato basket

 Melon-shaped

 Oblong flower

 Drop Handle, flower basket

A basket may be coarse, done with large material, and yet not produce a rough effect. Reed number "oo" to number six (lead pencil size) ^{is} procured by the pound. Strands are white and flexible. Dyed reed gives designs. "Scandinavian-made bluebirds nest in baskets fastened to boughs near buildings". (Hall, page 14). Cat and dog baskets are made of reed. Baskets with three-eighths inch basswood bottoms are made into plant holders. Coarse reed number five is used for spokes and number three and number four is best for weaving. Baskets for jardinières are stiffened with oil paints. Trays are most fascinating examples of the basket-makers' art.

Sewed or Coiled Baskets

1) Those twined and woven

2) Those sewed or coiled

Reed used	}	ellipse
Willow		oblong

Types of weaving are:

Lazy squaw	Knot-stitch-each stitch knotted
Pineapple	Navajo (water tight) firm as rock
Mariposa	Figure eight stitch
Peruvian	African wave stitch

African V-stitch

Navajo type made by the Apaches, Washoes of Nevada, Tulares and others. Dat-So-La-Le was an expert old Indian Washoe squaw. One of her baskets contains fifty thousand stitches (Hall, page 22), thirty to the inch, seven and one-half inches high, and ten inches in diameter. Her baskets excel in strength, smoothness, beauty of form, and in design. They are made of simple grasses, barks, and twigs, native to the region - dull browns and blues, willow twigs, red brown of red-bud bark, glossy black from maiden hair fern.

Raffia is the best material for ^{the} outer covering in coiled baskets. Indians used tan, brown-red, and golden brown/^{raffia.} Tulare bowl-basket raffia is sewed over reed as base - geometric designs are worked in in color. The Pomo Indian twined basket is famous for its lightness and flexibility and is woven. Spokes are of wild grape vine, closely woven, conical-shaped. They are carried in net and form a kind of granary, and are watertight.

Ferns - Filicineae

Baskets are woven from the Siamese climbing fern. "The slight, twining stems of this species, *Lygodium salicifolia*, climbing many feet, are cut and dried in the sun, after which their outer part is split into long, fine strips. No dyes are used. The work of weaving a single small basket-like covered box such as this requires three or four weeks." Geometric designs are woven in and they are readily sold to travellers. (Nat. Geog. Mag., May 1925, page 584).

Cinnamon Fern

Its great root-tussocks, rising well out of the moist areas where it grows, supply thick masses of wiry interwoven rootlets. These rootlets are regarded by those who cultivate tropical orchids as an ideal basket medium on which to grow the kinds of orchids that occur naturally on tree trunks. This material resists decay, and its open texture permits the free drainage that is essential. It is also used as a basket holder for growing tropical, epiphytic ferns.

"The stems of the maiden hair fern give a rich dark brown thread for outlining designs in baskets." (Marten, page 13).

Spruce Fiber

In the Arctic regions spruce *Picea*, *Pinaceae*, root is the material with which the coil is sewed. The Athapascan Indians of central Alaska wove with birchbark and spruce roots. Their finer baskets were made of hazel twigs, redbud, sweet-grass, pine root, and fern stalk. "The Kopi use yucca and fine grass; the Paiutis a coarse fiber, the Huvapais, willows. Southern California Indians use lute root and squaw weed; the Monos tender oak and willow shoots, roots and fibers; the tribes of the North, bark of the cedar and spruce roots." (James, page 73.) The Apache and Pima east of Oregon make coiled baskets, sifters and carrying baskets.

To gather, prepare, and manipulate the raw material meant patience and labor. The roots of spruce and cedar were macerated and torn into threadlike shreds, soaked for weeks in water to rid it of superfluous vegetable matter, and to render it strong and pliable.

Pine Needles

"The long and short needles of the pine trees are woven into baskets," (Marten, page 13.) by Indians of the near forest regions. The long-leaf pine, *Pinus palustris* or Georgia pine, grows from southern Virginia to the Savannas bordering the Gulf of Mexico, and from the Atlantic to the Rio Grande. When the needles are a rich brown, they are fully matured ready for use. The surface is hard and glossy. "In the spring and early summer pine trees show dried needles four to six inches long about to fall which often dry a light yellow brown." (Lang, page 79.) Green needles can be dried to any shade of brown. Then they are stored in a dark place. The young needles of "baby pines" dry almost like grass, soft in texture with little gloss. Exposure to light will change a green basket to brown. For this reason sewing material should be chosen with care. The keynote of design is simplicity in pine baskets. Sewing with sorghum fibers of red, orange, browns or violet brings out the beauty of pine needle color.

Pine needles must be worked damp enough to be pliable. The coil is made of a small roll of the needles, ten or twelve in number and wrapped with raffia to form the button which is the center of the basket. As the coil is used up additional needles are added so the smooth polished side is toward the outside of the basket. "Pine cones are often used as handles in baskets" (Lang, page 86). Many stitches, as the "Arrow" stitch, are used in the sewing. Pine baskets are often sewed with piassava fiber.

Grasses, sorghum fodder, other tones of pine needles, or raffia, may be worked in as bands around the basket, as broken bands, as vertical lines, or as spirals radiating from the center. The charm of pine needle baskets lies in even spacing, the smooth surface, the uniform size of the coil, the firmness of the work, form and color.

Grasses

Among grasses used in the woof, the smooth, wiry culms of "Vilfa and Sporobolus" were preferred. Sauvis and swamp ash and the vine-maple stems were split for baskets. In the Aleutian Archipelago baskets have been made from sea-island grasses, the fibers of which are soft and pliable. The baskets look more like bags,

Squaw's Grass

"The ornamentation of the baskets was done with Xerophyllum Tenax, or squaw's grass. It grows in the east side of the Cascade Mountains and can be gathered in late summer when the grass has matured". (James, page 76). The broad, swordlike leaves are split into the desired width, left white, or soaked yellow in color, or brown from a dye made from willow bark. "The Klamath make basket trays, the Skokomish covered baskets, Idaho tribes a pouch of cedar root and grass woven fine and full of design". (James, page 77).

Corn Husks

The baskets of the Cayuses, Umatillas, Nez Perces and Wascos and others living east of the Cascades are not stiffly woven, but are made of split corn husks and the wild hemp of the Walla Walla Valley.

Sweet Grass

The fine, white, exquisite grass, used by the Shasta Indians in making their baskets, is gained from great elevations in and about the snow-line of Mt. Shasta in summer. Walleets were woven by Nez Perce Indians from sweet grass and husks.

1. The first part of the paper discusses the importance of the study and the objectives of the research.

2. The second part of the paper describes the methodology used in the study and the data collection process.

3. The third part of the paper presents the results of the study and discusses the findings.

4. The fourth part of the paper discusses the implications of the study and the conclusions drawn from the research.

5. The fifth part of the paper discusses the limitations of the study and the areas for future research.

6. The sixth part of the paper discusses the contributions of the study to the field of research.

7. The seventh part of the paper discusses the practical applications of the study and the recommendations for practice.

8. The eighth part of the paper discusses the ethical considerations of the study and the measures taken to ensure ethical standards.

9. The ninth part of the paper discusses the acknowledgments and the funding sources of the study.

10. The tenth part of the paper discusses the references and the sources used in the study.

11. The eleventh part of the paper discusses the appendices and the additional information provided.

12. The twelfth part of the paper discusses the conclusion and the final thoughts on the study.

Bamboo

Is a tropical tree of the Grass family, Graminaceae. The stem is hollow with conspicuous joints. They grow in clumps or in groves in monsoon regions of Malay, India, Ceylon, and China. They are one hundred feet high. In the West Indies, the stems grow thirty-five feet high. The young shoots are dried and woven into baskets. In Siam the basket maker takes a few rods and split bamboo stems and weaves and coils. Tough grass is caught into the weaving to make the basket watertight. " Baskets are used as traps for fish, and carrying other goods as bread and vegetables." (Nat. Geog. Mag. 1927.)

Cereal straws of wheat, wild and cultivated rice are woven into baskets in Europe, India, in China and in the Americas.

Sweet-grass baskets made from *Hierochloë odorata*, a swamp grass, common in low areas along the coast and Great Lakes are a familiar sight in eastern North America. The Gayhead Indians of Martha's Vineyard and the Oldtown, Maine, tribes weave all types of baskets of this grass. Gypsy sweet grass baskets are seen in New England also.

Green Rush Fiber

Green rush (Juncaceae) comes from English rivers and ponds and Norfolk Broads. Sloping workboards facilitate the shaping of the sides of these baskets. A screwblock as a clamp is used for making the bases and lids for square baskets. A wooden mould is used for making woven rush baskets. Rush is woven into long, narrow, and thin shopping baskets. "Bottles were covered with weaving, rush usually was used by ^{the} ~~the~~ ^{the} ~~the~~ Indians." (White, page 173).

1900

1. The first of the year was a very cold day.

2. The second day was a very cold day.

3. The third day was a very cold day.

4. The fourth day was a very cold day.

5. The fifth day was a very cold day.

6. The sixth day was a very cold day.

7. The seventh day was a very cold day.

8. The eighth day was a very cold day.

9. The ninth day was a very cold day.

10. The tenth day was a very cold day.

11. The eleventh day was a very cold day.

12. The twelfth day was a very cold day.

13. The thirteenth day was a very cold day.

14. The fourteenth day was a very cold day.

15. The fifteenth day was a very cold day.

16. The sixteenth day was a very cold day.

17. The seventeenth day was a very cold day.

18. The eighteenth day was a very cold day.

19. The nineteenth day was a very cold day.

20. The twentieth day was a very cold day.

21. The twenty-first day was a very cold day.

22. The twenty-second day was a very cold day.

23. The twenty-third day was a very cold day.

24. The twenty-fourth day was a very cold day.

25. The twenty-fifth day was a very cold day.

Coconut Leaf Fiber

The large, pinnate leaves of the *Cocos nucifera*, grow six to twelve feet long, and eighteen inches wide. They are borne in a cluster at the top of the stem and are glossy and smooth. They are cut, dried, and used for basket making in the Orient and Pacific Islands. The petioles and midribs are used for the coils. "Types of palm baskets are envelope, cuff and collar, traveling case, glass case, hanging baskets". (White, page 131).

Creeping Palm Fiber

Pulp cane is the most suitable for weaving baskets and is pliable. The natural cane from which pulp cane is made is a species of creeping palm growing in the jungles and swamps of Java, Borneo, and Malaya. "There are twenty sizes of pulp cane and it is exported in one pound bundles, the first twelve sizes being excellent fiber size for basket making". (Winter's, page 119.)

Raffia

Coiled work in raffia has been done by the Apaches, Pimas, Pai Utes, and Navajo Indians for ages and by primitive women ^{of Madagascar}. The tribes today use the same designs as did their ancestors as "figure eight" for a work basket with tray and lid, the edges are plaited, the pattern and band shows the "knott-stitch". (Winter, page 134). In all parts of Africa, in North America, in Malaya, and the East Indies Islands and Pacific Islands coiled basketry is done with raffia.

To test raffia give it a quick pull, if it breaks, it is useless for coiled work. The raffia should be white. Sewing requires long-eyed, sharp and blunt needles.

Raffia comes from Madagascar in bundles weighing from one and one-third to three and one-half pounds and is called "monbas". Each monba contains soft, wide raffia, both long and short, corresponding to the fan shape of the palm leaf, and a good deal harder, stringy raffia which comes from the ribs of the leaves. The Indians made rattles of woven raffia on rattan spokes.

Willow

The willow, *Salix nigra*, is the most valuable commercially. "It reaches its best development in the flood plains in the Mississippi and Ohio valleys. The long, slender, pliable young shoots are used for wicker baskets." (Hill, page 122.)

Where the lithe willow or osier abounds, both its branch^{es} and bark are used, the larger stems for the frame and the lighter twigs for the filling of the baskets. These baskets stand upright and take the shape of pots, jars, and vases. When willow is soaked in water, it looks shriveled and does not weave in smoothly. The branches are slender, graceful, and filled with removable pulp. Since most of the Pacific Coast baskets were made for carrying water, the lightest, cleanest, whitest, and finest, most durable materials were selected as "chippa" willow by the Southern Indians, and *Cercus occidentalis* or red bud was used in the North. The interstices were filled with pitch from fir trees. Willow osiers are strong and flexible for basket-making. "In Portugal, boat-shaped baskets for carrying children on the head of the mother are made." (Nat. Geog. Mag. April 1887). In the Orinneys, in France, and elsewhere, vegetable baskets are of willow. In the grape regions of Spain, France, and Italy, large round, grape baskets are filled with that fruit and are on sale in the markets.

Willows grow on the banks of streams from the Arctic region in the north south to Chile; in Europe as far south as northern Africa.

Birch

Birch wood is hard, heavy, strong, and tough, with a fine grain. Yellow birch, ^{etula} *B. lutea*, which grows from New England to Georgia and black birch, *B. lenta*, are used in basket-making. (Hill, page 111.)

Plywood bases of baskets of birch and oak are bored or "take the stakes" as in basket trays.

Black Elm

California has long been the home of seven hundred thousand Indian basket weavers. Yokut and Lima baskets show colors and beautiful designs. The Yokut weave baskets of black elm, *Ulmus*, strips. Limbs, three to four inches in diameter, are gathered. "They are hammered with a wooden mallet until the individual layers break apart. These layers are then cut into narrow strips by means of the Indian knife. The strips are kept in coils, soaked in water, and woven into baskets." (James, page 70.)

Hazel

The Willamette Valley Indian squaws cut bundles of hazel sticks and carry them on their bent shoulders from the swamps for weaving their baskets. The Shastas use straight and strong sticks of hazel wood from ground, denuded by fire of its natural growth of hemlocks.

the first of these is the fact that the
 the second is the fact that the
 the third is the fact that the

the fourth is the fact that the
 the fifth is the fact that the
 the sixth is the fact that the

the seventh is the fact that the
 the eighth is the fact that the
 the ninth is the fact that the

the tenth is the fact that the
 the eleventh is the fact that the
 the twelfth is the fact that the

the thirteenth is the fact that the
 the fourteenth is the fact that the
 the fifteenth is the fact that the

the sixteenth is the fact that the
 the seventeenth is the fact that the
 the eighteenth is the fact that the

Chair-seating

A. Cane Seating

Cane is the bark of a long, slender vine, the inside of which is the material which is called reed or rattan. The cane is removed, the rattan is put through a tubular cutter which makes it a desired size. Cane is sold in bunches of a thousand threads. It comes in sizes:

Coarse

Medium

Fine

Fine-fine, most used

Cane is soaked to keep it flexible for weaving.

B. Rush seating is done with cat-tail leaves, growing in any inland marsh. Those near the ocean are too brittle. "They are gathered in the fall when the tips begin to turn yellow and are spread out straight on a board floor to dry, on boards laid on the floor so there is a circulation of air about them. If they are stored in a dark room they will remain green." (Hall, page 40.) Coils of several strands are twisted together. When woven colorless shellac is applied to the surface to preserve the fibers. Substitutes are fine corn husks and raffia. Golden rush is raised in Holland. (Winter, page 119).

The rope-like stems of the rattan palms wander through the tops of the great trees of the Malayan Peninsula to a length of several hundred feet.

. The rattan of commerce comes from the stems of Calamus giving a plentiful supply for chair-seats, bags, seats of vehicles, etc.

The first part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise record of all income and expenses, as this will be necessary for the preparation of the financial statements. The second part of the paper discusses the importance of maintaining accurate records of all assets and liabilities. It is essential for the company to have a clear and concise record of all assets and liabilities, as this will be necessary for the preparation of the balance sheet. The third part of the paper discusses the importance of maintaining accurate records of all equity transactions. It is essential for the company to have a clear and concise record of all equity transactions, as this will be necessary for the preparation of the equity statement. The fourth part of the paper discusses the importance of maintaining accurate records of all debt transactions. It is essential for the company to have a clear and concise record of all debt transactions, as this will be necessary for the preparation of the debt statement. The fifth part of the paper discusses the importance of maintaining accurate records of all other transactions. It is essential for the company to have a clear and concise record of all other transactions, as this will be necessary for the preparation of the other statements.

Nettins

Fly nets, for horses, sacks to hold Indian corn, crab or sea shell nets, hammocks, fish nets. "A net is durable because each stitch is perfect in itself, if it breaks, the web is not loosened. A large needle is used for hammocks and small one for lace and fringes." (Hall, page 46.) Three-sixteenths or an inch of gumwood or holly makes a large needle. A hammock should be laid on a long table and hooks/^{set}to fasten the rings.

String bags are made on a wooden hoop.

Basket-ball nets are cylindrical.

Tennis nets are oblong.

Curtain nets are made of coarse fibers.

III. C. Mats and Matting:

When man first began to think of interlacing strands to form a mat, he also thought of using various smaller fibers, rudely twisted together, in place of large strands. To him it was plain that a rope of twisted fibers had advantages over a single fiber of the same thickness. "As many fibers were too short to be woven, there was an obvious advantage in using many small fibers twisted into a single strand". (Winslow, page 182.)

The fundamental weaves in coarse mats are "over and under", "double over and under", "Japanese weave", "pairing", "triple weave", "coil", and "arrow" pattern. (Blanchard, page 6).

Fern

The Shoestring Fern, (*Vittaria lineata*) is a tropical fern that grow on the hummocks of Florida. It grows on the rough trunk of the Cabbage Palmetto (*Sabal palmetto*). The tufted fronds are thick and leathery and only one-eighth of an inch wide, resembling dark green shoestrings. They are cut and woven into covers and mats in the West Indies. (Nat. Geog. Mag., May 1925).

Western Red Cedar

The western red cedar, *Thuja plicata*, reaches a height of one hundred fifty feet and a width of thirty feet. The wood is brownish red, close, even-grained, soft and extremely durable. (Hill, page 101.) The coast Indians used this species for their totem poles, in summer wove the wigwam of strips of the bast fiber and also coarse mats from fibers of the inner bark.

Located in the Northeastern part of the State of Wisconsin on a reservation are the Menominee Indians. They are mat weavers. Mats are made from inner bark of the cedar cut in strips one-half an inch in width. Some mats are nearly white, while others are dark red or black.

Graminaceae

Job's-tears

This grass, *Coix Lacryma-Jobi*, is noted for its fruit which is large, shining, and pear-shaped. Job's tears are native to Southeastern Asia, and is cultivated in many tropical countries. Philippine adlay is raised for forage and is occasionally dried for mats. The chief use of the fruit is for weaving into necklaces and mats.

Rice Straw Matting

(*Oryza sativa*)
Rice is a large annual grass growing to a height of four feet.

It grows throughout the Orient, China, India, Ceylon and the Philippines. Rice is raised in California, Texas, Arkansas, and around the delta of the Mississippi River. (Hill, page 333). In hot countries where woolen rugs or mats are not practical, rice straw is woven into wall curtains, floor mats, chair mats, food mats and matting for roof and boat covers. The Chinese have fifty uses for rice straw matting.

Wheat Straw Carpets

Wheat is an annual grass, belonging to the genus *Triticum* and comprises wild and cultivated varieties. Cultivated varieties grow four feet high. Wheat stems are dried and known as "straw". It excels all other straws because of its great strength. It is tied in coils with hemp into straw carpets or hall matting.

Sedges

"Matting made from dried stems of the sedge, *Cyperus*, is an important export from Japan and southern China". (Toothaker, page 124). A hard, wiry sedge, *Carex stricta*, which grows wild in Minnesota is made into durable "grass" mattings.

Chinese mat grass, *Cyperus tegetiformis*, is made in the Orient into commercial mattings. Many are sold in Europe and in the United States for rugs and porch screens.

The sedge industry is practiced in Hampshire Longstock and Micheldever, England. They grow in the marshy ground of the River Test and three kinds (*Carex*) are used for plaiting. "They grow three feet high - fine sedges are

selected for small articles as mats and coarser ones for floor coverings. The leaves also are used for mats." (Roffey "Rush Work", page 71.) The sedge is cut at the end of July, and left spread out in the sun for two or three days. It is then tied up in bundles and hung in an open lean-to or shed for three weeks, when all the sharp 'cutting' edges will have disappeared. It is then plaited. Mats from the size of coasters to floor covers are made. Many sedge baskets are made of two or more mats sewed together.

Palms: Palmaceae

Coconut

The leaves enter into the manufactured products of both Europe and America. The leaves of the palms are fan-veined as in the fan palm, or feather-veined as in the date palm and coconut. These huge, pinnate or digitate leaves form a canopy at the top of the tall unbranched trunk. Palms are widely spread in warm regions: Asia, Africa, and in the tropical and semi-tropical America. They are conspicuous in the Pacific Islands where the trunk and leaves are stripped to weave into mats and wall covers, especially the coconut palm.

Sago Fiber

Sago Fiber comes from the leaves of the Metroxylon Sagu, a tall tree of the Orient. When the tree is half grown, or seven years old, the long leaves are collected from the top of the tall trunk. The leaves are stripped and dried for mat weaving. "Sago is a native of the tropics and it is cultivated in Malaya and the Dutch East Indies" (Hill, page 243.) The United States imported 1,175,010 pounds of sago fiber for mat-making in 1935.

Date Palm

The Massaabes of the Sahara raise groves of date palms for their fiber. "On the great coastal lands, enclosing the Persian Gulf, is an extensive-date-growing industry, and from this region the United States imports dates and fiber". (Whitbeck, page 490, 515.) The date gardens at the head of the Persian Gulf are of interest because of the unique method by which they are irrigated : the incoming tides check the outflow of the Shat el Arab River, raise the water level, and flood the adjacent date gardens.

In the United States, date palms are grown on the hot, irrigated desert of the Imperial Valley. They yield fibers no less valuable than those of Mesopotamia, but as yet in small quantities. The variety is the same, *Phoenix dactylifera*, grown in the Old, and in the New World. The date palm attains an ultimate height of seventy to a hundred feet. If allowed to remain, the old leaf bases with their fibrous sheaths encircling the cylindrical stem may persist for many years after the leaves themselves have been removed.

Numerous adventitious roots of the wild date, *P. sylvestris*, from one-quarter to one-half an inch in diameter arise from the base of the stem and penetrate the soil to depths of twenty feet or more. From these roots branch off smaller absorbing roots which develop in zones of optimum moisture and fertility. The leaves are large, ten to twenty feet in length, and pinnate. "On a mature palm each leaf has from one hundred to two hundred fifty leaflets including, in the lower portion, a number of spines. The life of a leaf is from three to seven years." (Robbins, pages 94-109). Sheaths, adventitious roots, and leaves are woven into mats.

Japanese Mat Rush

Commercial mattings are made in Manchukua, Japan, and Korea of Japanese mat rush or *Juncus effusus*. The rush is tied with dried hemp or soybean stems for rugs, and porch mats.

Rush, *Juncus acutus*, is a British material for mats. It is a tall, fibrous growth an inch in diameter at the butt, soft, and filled with spongy matter inside. It has no leaves, and only a few brown flowers on top. It grows to seven or eight feet in length, wild on brook, lake and river margins. "Between June and August men wade into the water with cutting-hooks and sever the rushes below the water-line. The crop is loaded into punts and boats, taken on to meadow land, tied into "bolts" (large bundles) and stacked up to dry like shecks of corn". (Roffey, page 71.)

Sometimes two or three weeks are sufficient for drying; rainy seasons longer. A wet spring followed by a dry summer gives excellent rush. The bolts weigh from nine to ten pounds when dry. The colors of the cured rush vary from grey-green to tan and light brown. Rush tends to change in color the longer you keep it. When bundles are open three lengths, large, medium, and small rushes are separated. Large rush make large mats.

Cleaning is done by dipping the rush in warm water and wiping down the rush from the tip to the butt. This cleans the rush and presses air from the stem, leaving the rush flat and pliable. "Wheeling mats and floor mats are made from thick plaits of rush, often one and a half inches wide and one-half inch thick. Odds and ends are sewed in for filling." (Roffey, page 77.) In weaving mats evenness is desired; to secure it thin ends of rush are cut off. In olden days, rush-bearing festivals were held, lovely green stems were strewn on floors, sometimes plaited stems or woven ones, to

be the floor covering for the year". (Roffey's "Rush-work", page 1.) Early types used were *Juncus effusus* or *Juncus conglomeratus*. "Rush-made splashers or mats have a charm no other material gives. There is great loss of weight in the drying off process, and a bundle of rush scales half its former weight after harvesting.

"Check", "pairing weaves", and "plaits" are handsome in tones of a color or in harmonizing colors in mats. Some mats are made of three-plaits, four-plaits, five-plaits, and six-plaits. In Europe and England a great deal of rush is dyed for use in making matting.

Raffia Mats

Raffia comes from the palm, *Raphia pedunculata*. The fiber comes in strips from the lower epidermis of the leaves, and is soft and silk-like and easily woven. The tree grows in Madagascar, in British West Africa, and in parts of South America. Majunga variety is the standard raffia of Madagascar and *R. Toedigera* from America. Good straw is pale and the length should be one and three-quarters yards.

"The weaves are "single", "pairing weave", "triple weave", "quadruple weave" and "open" for mats". (Begg, page 3.) Raffia is strong and durable, takes dye easily, is inexpensive, and ideal for articles of use and beauty.

Method of procuring the fiber is by peeling the skin from the surface of the leaflets of the palm by hand while the leaf is green. "In the lace or knot-stitch mat, reed is used for the coil and raffia is used for sewing. Raffia coil mats are made with the Hopi stitch". (Lang, page 69.)

A similar raffia palm yields a fiber which is used locally in West Africa and in Sierra Leone. Madagascar exports all types of mats made of

raffia. In 1935 the United States imported four hundred and fifty-eight tons of this fiber. (Hill, page 61).

Raffia mats serve in many ways in the house. They are useful, durable, and artistic as an ornament. Table mats are woven, ten, eight, six and four inches wide, for hot mats under covered dishes. They are woven oval, round, and rectangular in shape. The "brick, nucleus, and figure-eight stitch may be used". (Begg, page 32.) Table mat centers are made of natural raffia and wide borders are made of colored raffia. Plant mats, six inches in diameter are edged with lace loops in color. Large floor mats are worked in the "nucleus" stitch in varying shades of color. Large floor mats have four or more small mats joined together and the rest of the area filled in with a background stitch. Sizes vary from one yard to five feet long and four feet wide.

Gardening mats of raffia are comfortable and useful for kneeling upon, while gardening. A thick bind is covered with raffia. Smaller mats are made for chairs and piazza seats. Mats are made of sackings covered completely with stitches in colored raffia. Still another use for raffia mats is to hang them on the wall as a "splasher" over a washstand or over a couch where rubbing of pillows may occur." Wall hangings of raffia are beautiful when scenes or designs are done with color." (Begg, page 41.)

IV. Filling Fibers

These fibers are used in upholstery, and for stuffing mattresses and cushions. Filling fibers seal the seams in vessels, about pipes in plumbing, and in casks and barrels. (Hill, page 22.) Small or fragile fibers not used in textiles stiffen plaster, and are valuable as a packing material about bulkheads and for machine bearings and for protection of delicate

objects in transportation.

A. Seaweed Fibers

"Marine fiber is prepared from a seaweed, *Posidonia australis*, a marine algae of the *Thallophyta*. It is dredged up from shallow bays along the coast of South Australia." (Toothaker, page 125.) The seaweeds are dried and cleaned. They are then packed and shipped to Europe and America for heat insulation, upholstery, and as a mattress filler.

B. Sphagnum Moss

Sphagnum moss, *Sphagnum*: *Bryophyta*, grows in swamps and in peat bogs all over the world. Peat moss survives the winter by means of branches that start near the upper end of each plant; these branches live and grow the next year, while the older parts die. "In this way, the plants live and grow for centuries, the older parts being pressed and packed down and catching bits of plant and animal bodies which become entrapped in the tangle". (Allen's Botany, pages 94-95). As layers of this growth accumulate a semi-solid surface of plant-growth collects. Sphagnum is spongy and dangerous to collect. It is either gathered in boats; or rafts are made to stand on and the moss is collected with rakes. Other plant-growth is separated from it and the moss is washed and dried ready for packing material". (Bergen's Botany, page 268). It is put around potted plants, asparagus and cut flowers to hold moisture.

C. Pine-Needle Wool

"Pine-needle wool has been made from the leaves of the longleaf pine, *Pinus palustris*, of southern United States". (Toothaker, page 126). It occurs on the "uplands of the sandy Atlantic coastal plain from Virginia to

Texas". (Hill, page 99). Clusters of long needles form a heavy foliage on mature trees. Green and matured needles are dried for upholstery. A European species is used for filling material also.

D. Grain Straw Stuffing

This group includes a large number of fibrous materials of vegetable origin. The straw of grains as rice or oats, when threshed in an ordinary grain-threshing machine and ruined for textile purposes is put through a series of fluted rollers, which crush it and prepare it for a coarse stuffing material used in couches, car seats and carriage cushions.

E. Crin Végétal

Crin vegetal is a fiber obtained from a small palm (*Chamaerops humilis*), Palmaceae. It is native to Algeria and cultivated in southern Europe and northern Africa. "The leaves of the plant are shredded and the strands twisted into coarse yarn making, when picked open, an elastic material like curled hair". (Bailey's Horticulture 'Crops', page 293.) The saw palmetto, which grows over hundreds of acres in Florida and westward along the gulf coast of Texas gives a similar fiber.

F. Coir Fiber

Coir fiber comes from the husks of the coconut, *Cocos nucifera*. The husks are soaked in water until the fibers are soft. "Then they are torn apart, separated and cleaned. Coir is a coarse, stiff, springy fiber. Much of it is somewhat curly and valuable for stuffing in upholstery." (Toothaker, page 122.)

G. Oil Palm Fiber

Oil palm fiber comes from *Elaeis guineensis*, Palmaeaceae. It grows wild in the Rain Forests of West Africa and in 1929, Nigeria produced one-half of the world's supply of oil-palm products. "This tree requires fifty to seventy inches of rain; and well-drained soil away from the coastal swamps." (Case, page 180-181).

Each tree bears ten bunches of two hundred nuts a year and the fibrous pulp of these fruits, which is left after the oil is pressed out, is dried and known as "palm-kernel cake". Five hundred thousand tons of fiber cake comes from the oil extracting mills of Europe and the United States. These short fibers are sold to thicken clay and to mix with plaster for homes and buildings.

H. Spanish Moss

Spanish, or Long Moss, belongs to the pineapple family, Bromeliaceae, and drapes itself on live oak and cypress trees in the southern states, Virginia, to Florida to Texas, along rivers and bayous. Its native home and the United States. is tropical America. The leaves of many species are colored or grayish and usually scurfy. (Ganong's Botany, pages 463, 535). The flowers are showy in some species, in Spanish moss, small and inconspicuous. Being a true epiphyte it absorbs most of its food directly from the atmosphere. It is injurious to the orange, oak and other trees upon which it grows.

In many places in the south, Florida for example, it is collected and placed in heaps to be fermented to loosen the outer covering, which is removed by running through a revolving toothed cylinder and toothed concaves. The tough inner fibrous material looks like horsehair and is used as a

stuffing for cushions and mattresses, couch hammocks and overstuffed furniture.

Willandsia fasciculata is a stiff plant with a basal rosette of gray-green, narrow leaves twelve to eighteen inches long. The flowers are blue and in spikes four to six inches long. They are raised in Central America and the West Indies for shade and wall covers. (Garden Dictionary, page 905.)

T. lindeneana is a showy plant with a basal rosette of leaves which are twelve inches long and three-quarters of an inch wide. They are native to Ecuador and Peru and dried for stuffing matter for mattresses and bags. Much of the filling material is exported.

I. Kapok : Bombacaceae

Kapok, or silk cotton, is a cream-colored seed hair from pods of a large tree, *Ceiba pentandra*, or *Eriodendron anfractuosum*. Most of this fiber on the market comes from Java. "Similar fibers are produced by various 'cotton trees' in the tropics (*Bombax* and *Ochroma* sp.) but most of these are less elastic, browner in color, and shorter in staple than kapok". (Toothaker, "Raw Materials", page 112). Kapok is raised in the Moluccas or Spice Islands in a belt of equatorial calms with a heavy rainfall, a large part of the year. (Packard and Simmott's "Nations as Neighbors", page 364.)

Ceiba pentandra, which produces the kapok of commerce, has been introduced into Florida. (Nature Magazine, March 1938, page 170). "Kapok trees grow to great size, frequently reaching a height of one hundred feet and have buttressed base twenty feet or more across. Horizontal, wide reaching branches are in whorls, almost at right angles to the trunk. The leaves are compound, with from five to nine leaflets and grow up to six inches in length."

The flowers are profuse and attractive. Two months after flowering the fruits ripen, these contain seeds surrounded by silky floss. It is used for stuffing upholstery, cushions and life buoys, and in its native home it is used for bedding and pillows. A fiber for cordage comes from the inner bark.

J. White Silk Cotton (*Cochlospermaceae*)

The white silk cotton, *Cochlospermum Gossypium*, yields a kapok-like fiber of value to man. "It is a handsome Indian tree now widely cultivated in the tropics. A red silk cotton, *Bombax Ceiba*, is a large ornamental tree and gives a reddish floss." (Hill, page 153). Both white and red silk cotton have been important stuffing materials in India for years.

K. Madar

The madar (*Calotropis gigantea*), *Asclepiadaceae*, a shrub that is found from India to the Moluccas, produces a silk cotton and a bast fiber. A closely related type, *C. procera*, yields a similar product. They are inferior to kapok and are used in mixtures with kapok as a filling material.

L. Other Fibers

Milkweed (*Asclepias syriaca*) of eastern North America and *A. curassavica* of tropical America have conspicuous silky hairs on the seeds which are good for stuffing cushions and pillows.

Oakum is used for caulking the seams of vessels, and packing about joints in pipes.

Philippine cabo negro fiber is a horsehair substitute and sold to manufacturers for lining for men's suits, couch pillows and cushions. The many

fibers, for filling purposes mentioned, show man gathers and uses plant materials of his environment to great advantage.

V. Natural Fabrics

"Natural fabrics" are usually tree basts which are extracted from the bark in layers or sheets, and pounded into rough substitutes for cloth or lace. " (Hill, page 22.)

A. Rabannas

Rabannas are woven mats or fabrics from *Raphia pedunculata*, Palmaceae. This stem substance comes from Madagascar and is exported to Europe and America.

B. Upas Tree Bark Cloth (Moraceae)

A common bark cloth of Ceylon and Malaya is obtained from the upas tree (*Antiaris toxicaria*). The ^{bark} is pounded with wooden mallets into sheets that are thin and soft and can be woven into cloth.

C. Tapa Bark Cloth

One of the common bark cloths is Tapa, which is obtained from the bark of the paper mulberry (*Proussonetia papyrifera*): Moraceae. Strips of the bark are peeled off the trunk and shells are then used to remove an undesired outer coating. They are then soaked in water and scoured. The strips then are placed on a log of hard wood and pounded with a mallet. The strips are overlapped and beaten together. If a muslin-like material is desired much beating is required. Tapa cloth may be made into a leathery fabric by less beating. The cloth is dyed, is soft, lustrous and waterproof when oiled. It is the native clothing in Polynesia and Eastern Asia. When tapa is mixed with mucilage and stretched, lanterns and umbrellas are made of it.

D. Mutshu Cloth (Moraceae)

"In Mozambique a wild fig (*Ficus utilis*) is used as the source of the native mutshu cloth". (Will, page 54.)

E. Guba Bast (Malvaceae)

"Guba Bast is obtained from *Adisans elatus*, a small bushy tree of the West Indies." The bast is beautiful and lacy. The inner bark is torn in ribbon-like strips which are used in hat-making and trimmings, and are used to tie cigars.

F. Lace Bark (Thymelaeaceae)

"Lace Bark comes from *Lapetta lintearia*, a small tree native to the island of Jamaica." The tree has a smooth straight stem and oval leaves. The tough fibers of its inner bark when soaked in water separate into thin lacelike layers. They are stretched, making pentagonal meshes, and dried for ornamental use and textiles. (Sourcebook Encyclopedia, Vol. IV, page 1572, and Will, page 54.)

G. Tawary Cloth (Lecythidaceae)

"The South American Indians use the bark of tawary (*Couratari Pauari*) for primitive cloth for coverlets and clothing."

H. Vegetable Sponge

The Cucurbitaceae give a plant, *Luffa cylindrica*, whose unique fiber comes from the fruit of this climbing, tropical cucumber. The fibers are stiff and curled. This yellowish skeletal material is extracted by soaking in water, and is much used in making hats in Korea and Japan. Japan exports large quantities of this material to southern Europe and the United States for millinery purposes.

THEORY OF THE EARTH

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

THEORY OF THE EARTH

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

THEORY OF THE EARTH

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

The theory of the earth is a branch of geology which deals with the origin and development of the earth and its various parts.

II. Conclusion

It is interesting to note, after a study of the different plant fibers, that primitive and civilized man exploited the four sub-kingdoms of the plant world from ^{the}Thallophyta, the spore-prod/^{using}plants, to ^{the}Spermatophyta, the seed plants, for fibers for his own use and comfort. He went to the Indian Ocean, off the coast of Australia, for algae (Thallophyta), for upholstery stuffing; to the woods where the cinnamon, climbing, and maidenhair ferns (Pteridophyta) grow, and chose the stems for weaving dark brown color into baskets and mats; he went to the forests for red cedar/^(Pinaceae) for pine needles and cones, yellow pine fiber and for spruce roots to record his religion in his weaving.

The screw pine, Pandanaceae, of Formosa and Japan, is next chosen for its sword-shaped leaves for its fibers for hat straws; the Gramineae (Hill, page 529) give bamboo, Job's tears, millet straw, broomroot, sweet grass, rice straws, broomcorn, various wheat straws, and corn stalks and husks, for hats, baskets, mats and matting, and filling fibers. The Cyperaceae give papyrus and Chinese mat grass for paper and fabrics; the Palmaceae give Bahia piassava, Palmyra palm, Fan palm, Coconut coir and leaves, Oil palm, Para piassava, Sago palm, Date palm, Raffia palm, Puerto Rico hat palm, and Palmetto stem or leaves or fruit for fibers for hats, clothing, plaitings, thatch, cloth and baskets.

The Cyclanthaceae produce Panama hat palm fiber, which is made into the world's best hat; Bromeliaceae give Pineapple leaf fiber for weaving and Spanish moss for stuffing mattresses and cushions; Juncaceae give rushes for chair seats, mats and baskets; Liliaceae give aloes, New Zealand hemp, Florida, Indian, African, and Ceylon bowstring hems, for ropes, twine, mats,

baskets and coarse fabrics; Palma istle also for cordage.

Amaryllidaceae give Taguey, Cenequen Jaurave and Tula istle, Sisal, Mexican Taguey, Mauritius and Cuban hems for cordage, sailcloth, leaves for thatch; Musaceae give plantains for thatch and Manila hemp for cordage; Salicaceae give willow and aspens for wickerwork: baskets, carriages, and furniture. Betulaceae give alder and birch for basketry. Ulmaceae give elm for baskets; Moraceae give Paper mulberry for primitive cloth, Hemp for cordage and mats; Urticaceae give Rhea for canvas and cordage; Lauraceae give Massoia bark and Sassafras for cloth and basketry; Hamamelidaceae twigs of Witch Hazel are collected for basketry by the Indians; Leguminosae give Sunn Hemp for cordage, Rosewoods for brush handles, and Colorado river hemp for cords and twines; Tiliaceae give jute for burlap, for lin oleums and canvas.

Malvaceae give Deccan hemp, Cuba bast, Okra, Rama, Majagua, Cuba jute, and Aramina for cordage and weaving fibers. Bombacaceae give Red silk cotton and Kapok for stuffing cushions and mattresses. Cochlospermaceae give White silk cotton, a stuffing substitute for Kapok; Apocynaceae give Indian hemp for cordage; Asclepiadaceae give Madar and Akund for primitive cloth making; and Cucurbitaceae give Vegetable sponge for hats in Korea and Japan.

I have endeavored to show by the preceding paragraphs the position of the different plants in the plant kingdom, the relationships of the various fiber plants and their innumerable uses to man.

Bibliography

- Allen, Charles E. and
Gilbert, Edward S. Text Book of Botany
D. C. Heath and Company
Boston, 1917
Sphagnum Moss, pages 94, 95
- Americana Encyclopedia Americana Corporation
New York, 1936
Vol. II. Fibers, page 165 on.
Ramie, page 202
- Bailey, Liberty H. Cyclopedia of American Agriculture
Macmillan Company, New York, 1927
Four volumes
Volume II. Crops. Fibers.
- Standard Cyclopedia of Horticulture
Macmillan Company, New York. 1921
Volume I. Agaves. Pages 230-238
- Pegg, Annie L. Raffia
Sir Isaac Pitman and Sons, Ltd.
London, England. 1930
Weaving, pages 80-86; Mats and Screens,
pages 32-43.
- Bergen, Joseph Y. and
Caldwell, Otis W. Introduction to Botany
Ginn and Company, Boston. 1914
Sphagnum, page 267
- Blanchard, Mary Hiles The Basketry Book
Charles Scribner's Sons. 1924
New York.
Weaves. Pages 6 - 15
- Case, Earl C. and
Bergsmark, D.B. College Geography
John Wiley Sons, Inc.
New York, 1932
Jute, pages 207-209; Sisal, pages 209-210;
Sago palm, page 184.

- Clute, W. H. The Useful Plants of the World
Willard and Clute and Company
Indianapolis, Indiana. 1932
Pages 3, 15, 21, 36, and 40
- Corkiter, John M. Elementary Studies in Botany
D. Appleton Company
New York 1913
Sunn Hemp, page 417
- Foster, Alice Sisal Production in Semi-arid Harst
Journal of Geography Assn.
New York. 1930
Country of Yucatan, Vol. XIII, pages 16-25
- Garden Dictionary Tillandsia, page 805
Abaca, page 514
1932
- Gager, C.S. General Botany
P. Blakiston's Son and Company
Philadelphia, Pa. 1926
Rattan, Bamboo.
- Canong, William College Botany
Macmillan Book Company
Boston. 1924
Pages 463, 535.
- Hall, Herbert J. and
Knox, M.C. Handicrafts for Handicapped
Dodd, Mead and Company
New York. 1928
Basketry, pages 7-20; Chair seating, 33-39;
Netting, page 45; weaving, pages 59-78.
- Will, Albert F. Economic Botany
McGraw, Hill and Company
New York. 1937
Page 22, and on.
- Hill, Henry Chase Wonderbook of Knowledge
John C. Winston Company
Philadelphia, Pa. 1926
Rope, pages 122 - 138;
- International Encyclopedia Dodd and Meade Company
New York 1928
Panama Hat Palm, page 2401, and others.
Fibers, pages 576-578

James, George Thorton

Indian Basketry
Third Edition
Henry Malken Company
New York, 1903
Basket Fibers, pages 72 - 85

Lang, Mrs. Edwin

Basketry, Weaving, and Design
Charles Scribner's Sons
New York 1925
Reed Weaving, page 3; Raffia, page 68;
Fine Needle Basketry, page 78.

Marten, William S.

Inexpensive Basketry
Manual Arts Press
Peoria, Illinois 1913
Pages 1 to 16.

McGraw, Will Book Company

Forest Resources of the World
McGraw Hill Book Company
New York 1923
Pages 435-36

Winter, David C.

Modern Home Crafts
John Hopkins and Sons, Inc.
New York and London. 1937
Weaving, page 34 and on; Basketry, pages
119-132; Raffia, pages 134-141.

National Geographic
Magazine

National Geographic Society
Washington, D.C.
May, 1925. Ferns
November, 1920. Rice Straw, pages 402-403.
Bamboo Products of China, pages, 356,
358, 359, 372.
February, 1919. Sarawak: Rattan Vine.
page 158.
Nibong Palm, page 159.
Rattan Mats, page 128.
Palm Products, page 137.
January, 1921. Palm Leaves for Thatch,
page 52 and on.
Ropes, Weaving: Afghanistan, page 102.
February, 1921. Thatch and Weaving: Czechoslovakia, pages 6 and 10.
Mat Market of Bulgaria, page 180.
Fishermen and Cottage Ropes, page 221.
March, 1921. Jute and Straw Covered Boats:
Calcutta.
Bamboo Boats of Mats, pages 314-317.
Hemp Strings over Rice Fields, page 308
Seventy Fiber References, 1917-1935.

1871

1872

1873

1874

1875

1876

1877

1878

1879

1880

1881

1882

1883

1884

1885

1886

1887

1888

1889

1890

1891

1892

1893

1894

1895

1896

1897

1898

1899

1900

1901

1902

1903

1904

1905

1906

1907

1908

1909

1910

1911

1912

1913

1914

1915

Packard, Leonard, and
Simmott, Charles P.

Dotary
Macmillan Book Company
New York 1930
Kapok, page 364.

Redway, Jacques W.

Commercial Geography
Charles Scribner's Sons
New York 1910 and 1920
Rumie, page 123; Hemp, pages 121 and 257;
Sisal, page 122.

Robbins, Wilfred W. and
Ramaley, Francis

Plants Useful to Man
P. Blakiston Sons
Philadelphia, Pa. 1933
Coco Palm and Coir, pages 101-104;
Yucca, pages 112-113; Hemp, page 181;
Pineapple, page 301.

Roffey, Mabel

Simple Baskets
Sir Isaac Pitman Sons Ltd.
London. 1930
Rush, pages 71 and on.

Roffey, Mabel, and
Cross, Charlotte S.

Rush work
Sir Isaac Pitman Sons, Ltd.
London, 1933
pages 1 to 28.

Schroder, Ruth W.

Kapok Tree
Nature Magazine, Vol. XXVI, Number 3.
March, 1938

Sourcebook Encyclopedia

Perpetual Encyclopedia Corporation
Chicago, Illinois. 1933
Vol. I., page 401

Standard American
Encyclopedia

Standard American Corporation
Chicago, Illinois. 1937
Vol. III. Crushes

Taylor, Norman

Garden Plants
Houghton, Mifflin Company
Boston 1936
Broomecorn, page 332; Coco nucifera, page 155;
Sesbania, 729

Toothaker, Charles R.

Commercial Raw Materials
Cinn and Company
Boston, 1927
Pineapple, page 122; Others, 104 to 133.

United States Department
of Agriculture

Fiber Investigation Office
Special Report, Number Eight, pages 1 - 16.

United States Department
of the Interior
Bureau of Ethnology

Indian Arts
Pamphlet Number sixteen, pages 1 - 38

Matson,

Bulletin: Royal Kew Gardens
Economic Products of India
Pages 1 - 7

Whitbeck, Ray W. and
Finch, Verna

Economic Geography
McGraw, Hill Company
New York 1935
Henequen, page 273; New Zealand Hemp,
pages 530-532; Sisal, Page 273.

White, Mary

How to Make Baskets
Doubleday, Page Company
New York. 1913
Palm Baskets, pages 131 and on.

The first part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise system in place to ensure that all financial data is properly documented and easily accessible. This will help in the preparation of financial statements and provide a clear picture of the company's financial health.

The second part of the paper focuses on the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise system in place to ensure that all financial data is properly documented and easily accessible. This will help in the preparation of financial statements and provide a clear picture of the company's financial health.

The third part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise system in place to ensure that all financial data is properly documented and easily accessible. This will help in the preparation of financial statements and provide a clear picture of the company's financial health.

The fourth part of the paper focuses on the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise system in place to ensure that all financial data is properly documented and easily accessible. This will help in the preparation of financial statements and provide a clear picture of the company's financial health.

The fifth part of the paper discusses the importance of maintaining accurate records of all transactions. It is essential for the company to have a clear and concise system in place to ensure that all financial data is properly documented and easily accessible. This will help in the preparation of financial statements and provide a clear picture of the company's financial health.

BOSTON UNIVERSITY



1 1719 02555 0015

